

PS Sedimentary Simulation to Analyze Burial Diagenesis and Petroleum System of the Upper Tertiary Sequences in Southern Ulleung Sedimentary Basin, East Sea (Sea of Japan)*

Daekyo Cheong¹, Daehong Kim², and Seung Hoi Cha²

Search and Discovery Article #40651 (2010)

Posted December 6, 2010

*Adapted from poster presentation at AAPG Convention, Calgary, Alberta, Canada, September 12-15, 2010

¹Department of Geology, Kangwon National University, Chuncheon, Republic of Korea (dkcheong@kangwon.ac.kr)

²Department of Geology, Kangwon National University, Chuncheon, Republic of Korea

Abstract

The block 6-1 located in the southwestern margin of the Ulleung Basin, East Sea (Sea of Japan) is an area that recently produces commercial natural gas and condensate. A total of 17 exploratory wells have been drilled, and also many seismic explorations have been carried out since early 1970s. Among the wells and seismic sections, the Gorae 1 well and a seismic section through the Gorae 1-2 well were chosen for this simulation work. Then, a 2-D graphic simulation using SEDPAK elucidates the evolution, burial history and diagenesis of the sedimentary sequence. The study area is a suitable place for modeling a petroleum system and evaluating hydrocarbon potential of the reservoir. Shale as a source rock is about 3500m deep from the sea floor, and sandstones interbedded with thin mud layers are distributed as potential reservoir rocks from 3,500m to 2,000m deep. On top of that, shales cover as seal rocks and overburden rocks up to 900m deep. Input data (sea level, sediment supply, subsidence rate, etc) for the simulation was taken from several previous published papers including the well and seismic data. The thermal maturity of the sediment was calculated from known thermal gradient data. In this study area, gas and condensate have been found and commercially produced. The result of the simulation also shows that there is a gas window between 4000m and 6000m deep, so that three possible interpretations can be inferred from the simulation result. First, oil has already moved and gone to the southeastern area along uplifting zones. Or second, oil has never been generated because organic matter is kerogen type 3, or finally, generated oil has been converted into gas by thermally overcooking. SEDPAK has an advantage that it provides the timing and depth information of generated oil and gas with TTI values even though it has a limit which itself cannot perform geochemical modeling to analyze thermal maturity level of source rocks. Based on the result of our simulation, added exploratory wells are required to discover deeper gas located in the study area.

References

- Haq B., J. Hardenbol, and P.R. Vail, 1987, Chronology of fluctuating sea level since the Triassic (250 million years to present): Science 235, p. 1156-1167.
- Lee, G.H., B. Kim, S.J. Chang, S. Huh, and H-J Kim, 2004, Timing of Trap formation in the Southwestern margin of the Ulleung Basin, East Sea (Japan Sea) and implications for hydrocarbon accumulations: Geosciences Journal, v. 8/4, p. 369-380, DOI: 10.1007/BF02910473.
- Lee, G.H., et al., 2007, Petroleum System Modeling of Continental Shelf Area, Southwestern Margin of the Ulleung Basin, East Sea: Journal of the Geological Society of Korea, v. 43/4, p. 477-499.

Sedimentary Simulation to Analyze Burial Diagenesis and Petroleum System of the Upper Tertiary Sequences in Southern Ulleung Sedimentary Basin, East Sea (Sea of Japan)

Daekyo Cheong, Daehong Kim*, Seung Hoi Cha

Kangwon National University, Chuncheon 200-701, Korea

* e-mail: foreverdh15@hanmail.net



Abstract

The block 6-1 located in the southwestern margin of the Ulleung Basin, East Sea (Sea of Japan) is an area where recently produces commercial natural gas and condensate. A total of 17 exploratory wells have been drilled, and also many seismic explorations have been carried out since early 1970s. Among the wells and seismic sections, the Gorae 1 well and a seismic section through the Gorae 1-2 well were chosen for this simulation work. Then, a 2-D graphic simulation using SEDPAK elucidates the evolution, burial history and diagenesis of the sedimentary sequence. The study area is a suitable place for modeling a petroleum system and evaluating hydrocarbon potential of reservoir.

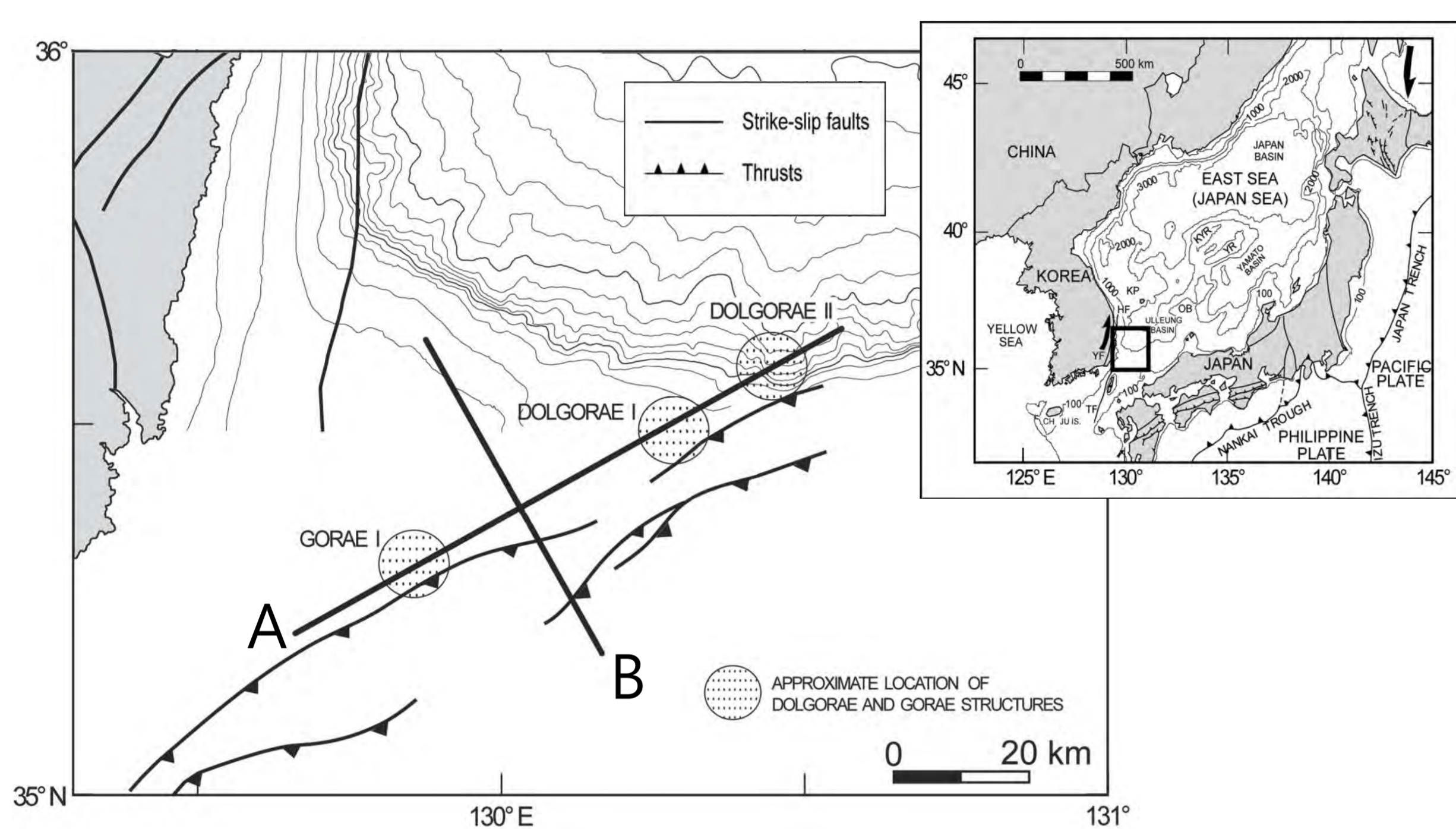


Fig. 1. Location map of the study area (Lee et al., 2004).

Method & Materials

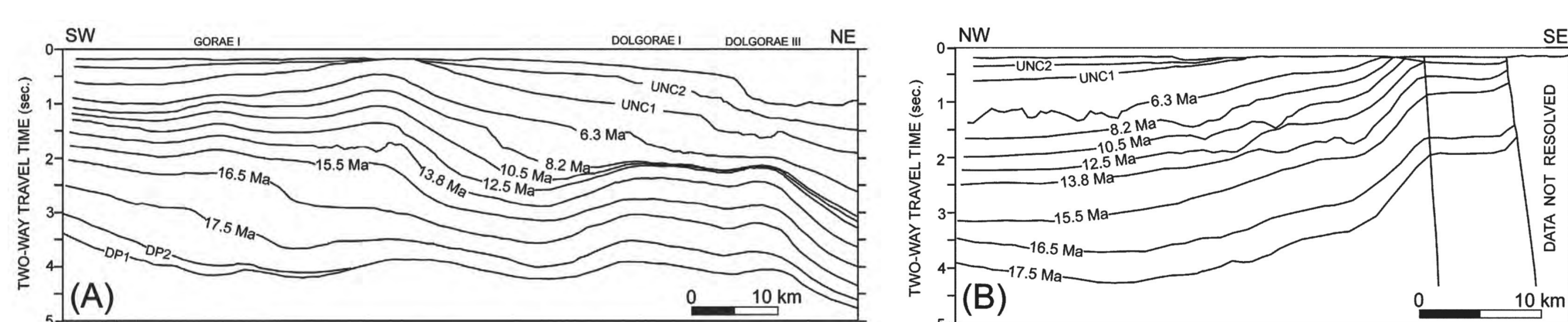


Fig. 2. Seismic interpretation of the line A and B (Lee et al., 2004).

Rock unit	Begin age (Ma)	Top depth (m)	Lithology	Petroleum system event
U. Pleistocene	0.9	0	Shale 100%	
Late Pliocene	3.6	720	Sandstone 100%	
Early Pliocene	5.3	870	Sandstone 100%	
Late Miocene	10.5	1010	Shale 70%, Sandstone 30%	Seal
Middle Miocene	16.3	2130	Shale 30%, Sandstone 70%	Reservoir
Early Miocene	23	3710	Shale 100%	Source

Table 1. Lithology of Gorae-I well data (Lee et al., 2007).

Conclusion

Simulation results show aggradation and progradation until middle Miocene (12.5 Ma). Subsequently, the basin began to uplift because of deformation in the southeastern part of the Ulleung basin. In this study area, gas and condensate have been found and commercially produced, and the result of the simulation also shows that there is a gas window between 4000 m and 6000 m deep, so that three possible interpretations can be inferred from the simulation result. First, oil has already moved to the southeastern area along uplifting zones. Or second, oil has never been generated because organic matter is kerogen type III, and or finally, generated oil has been converted into gas by thermally overcooking.

Reference

- Haq B., Hardenbol J., vail P.R., 1987, Chronology of fluctuating sea level since the triassic (250million years to present). Science 235, 1156-1167.
- Lee et al., 2004, Timing of Trap formation in the Southwestern margin of the Ulleung Basin, East Sea (Japan Sea) and implications for hydrocarbon accumulations, Geosciences Journal, V. 8, No. 4, p. 369-380.
- Lee et al., 2007, Petroleum System Modeling of Continental Shelf Area, Southwestern Margin of the Ulleung Basin, East Sea., Journal of the Geological Society of Korea, V. 43, No. 4, p. 477-499.

Simulation Results

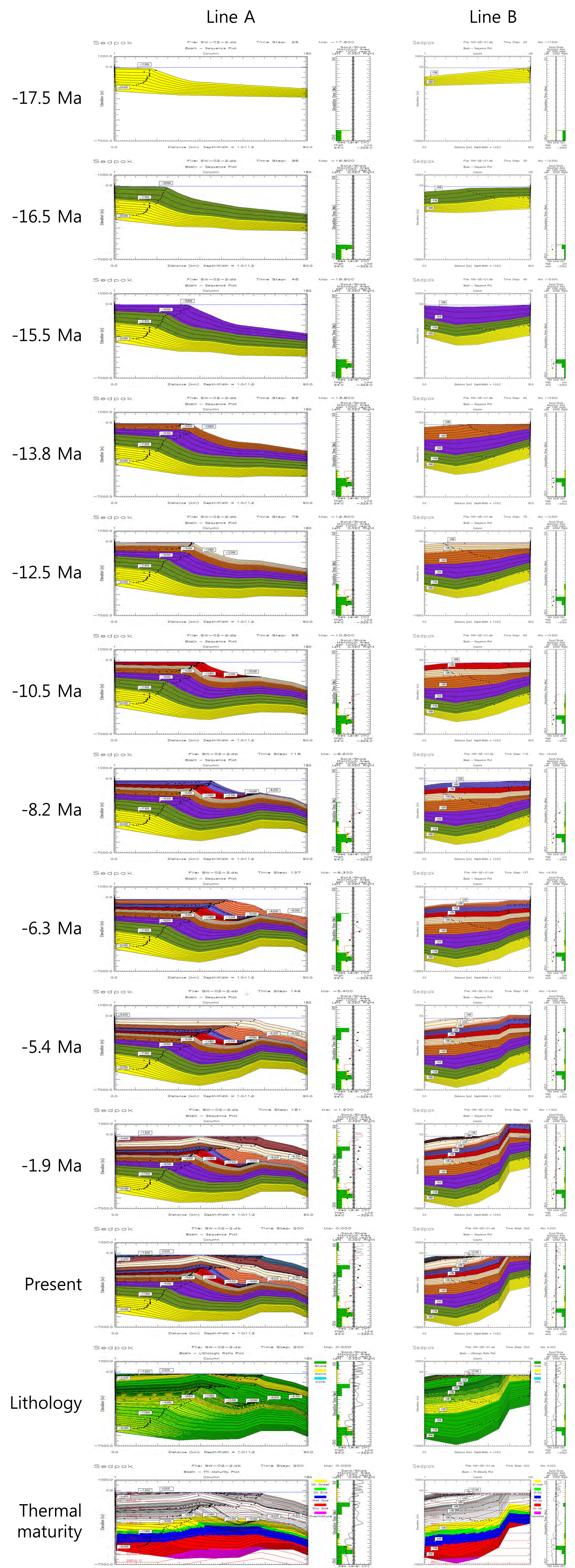


Fig. 4. Simulation result shows the evolution of sedimentary sequence, lithology and thermal maturity.