[PS]Reconstruction of Burial Diagenesis by 2-D Sedimentary Simulation and Analysis of Petroleum Potential of the Upper Tertiary Sequences in Southern Ulleung Sedimentary Basin, East Sea (Sea of Japan)*

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Abstract

The southwestern margin of the Ulleung Basin, East Sea (Sea of Japan) is an area that has recently produced 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 1970's. Among the wells and seismic sections, the Gorae 1 well and a seismic section through the Gorae 1-2 well were chosen for reconstruction of burial diagenesis in terms of 2-D sedimentary simulation. The study area is a suitable place for modelling a petroleum system and evaluating hydrocarbon potential of reservoirs. Shale as a source rock is about 3500 m deep from the sea floor, and sandstones interbedded with thin mud layers are distributed as potential reservoir rocks from 3500 m to 2000 m deep. On top of that, shales cover as seal rocks and overburden rocks to 900 m deep.

The thermal maturity of the potential source rock was calculated from known thermal gradient data. In this study area, only gas and condensate have been found and commercially produced, and the result of 2-D sedimentary simulation shows that there is a gas window between 4000 m and 6000 m deep, so that three possible scenarios can be inferred from the simulation. First, oil has already moved and gone to the southeastern area along uplifted 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. The 2-D sedimentary simulation has an advantage that it provides the timing and depth information of generated oil and gas with TTI values. Based on the result of our simulation, added exploratory wells are suggested to discover possible deeper gas reservoirs located in the study area.

Reconstruction of Burial Diagenesis by 3-D Sedimentary Simulation and Analysis of Petroleum Potential of the Upper Tertiary Sequences in Southern Ulleung Sedimentary Basin, East Sea (Sea of Japan)

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Abstract

The Ulleung Basin is a back-arc basin located in the southwestern part of the East Sea (Sea of Japan), containing thick (over 5 km) late Tertiary to Quaternary sediments. The opening of the East Sea was initiated by crustal thinning in the Early Oligocene, resulted in a relatively high sediment accumulation in the southern margin of the Ulleung Basin. During the late Miocene (12 Ma), changes of the plate motion and subduction mode along the subduction zone caused back-arc closure, resulting in a relatively low sediment accumulation throughout the basin and a numerous structures in the southeastern margin of the Ulleung Basin.

In study area, 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, four wells and three seismic sections were chosen for this simulation work. Then, 2D and 3D graphic simulations 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.

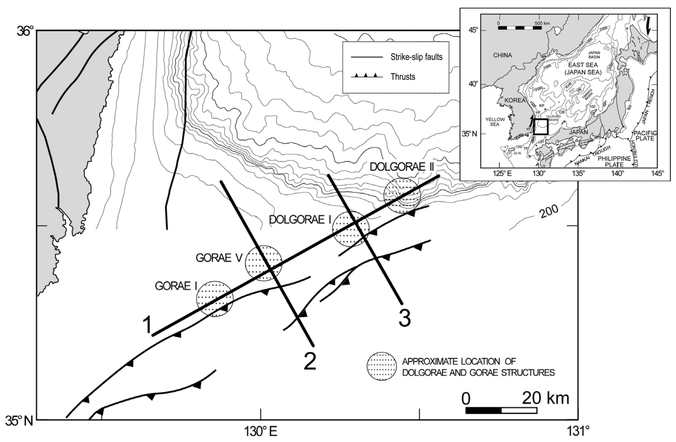

Fig. 1. Location map of the study area (Lee et al., 2004).

Flow Chart

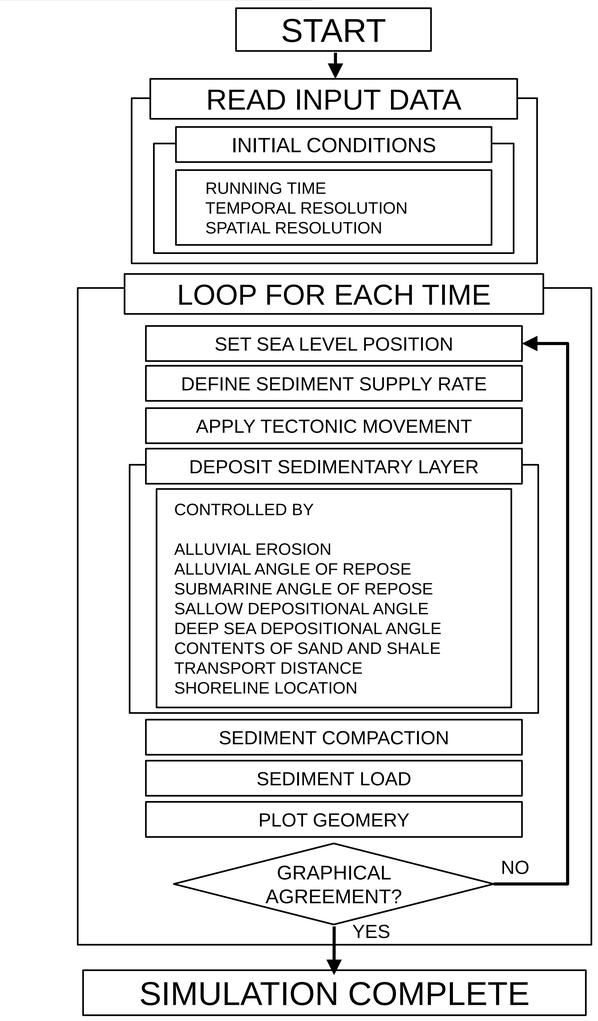

Fig. 2. Flow chart of SEDPAK forward modeling process (Lee et al., 2004)

Method & Materials

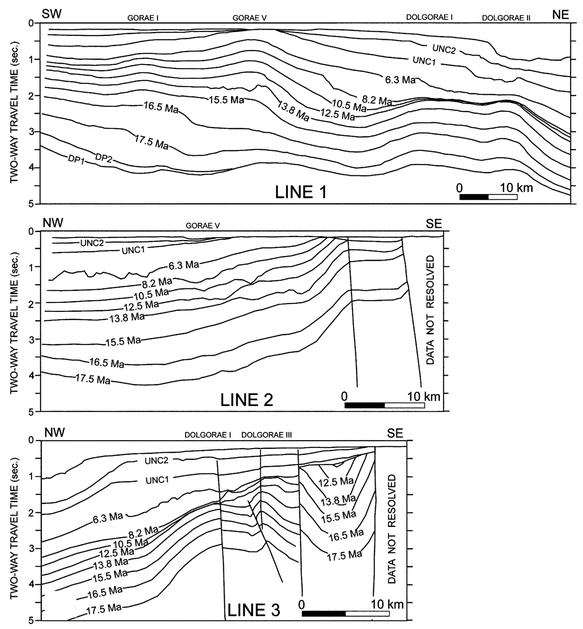

Fig. 3. Seismic interpretation of the line 1, 2 and 3 (Lee et al., 2004).

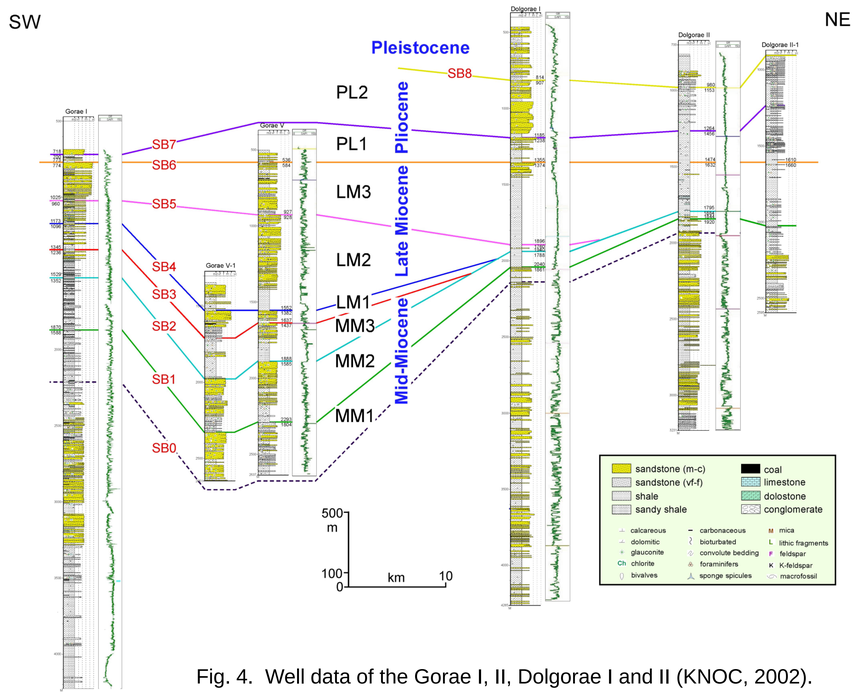

Fig. 4. Well data of the Gorae I, II, Dolgorae I and II (KNOC, 2002).

Fig. 5. Input data of the Line 1, 2 and 3.

Conclusions

The sequence simulation result shows very thick (over 6 km) sedimentary layers during the Middle Miocene to Quaternary. Also the simulation result indicates that sedimentary layers are aggradational and progradational until late Middle Miocene (-12.5 Ma). Subsequently, the basin began to uplift because of tectonic compression. At that time, many structures were generated around the southeastern part of Ulleung Basin.

The lithology and facies results show that sedimentary layers are progradational toward the basin center. During the Late Miocene (-8 to -6 Ma), clastic supply from the southeast shows relatively high because of sediment supply eroded from the southeastern uplift zone.

The simulation result of maturity indicates that an oil and gas window exists between 3000 m and 5000 m deep. However, the study area has only gas and condensate discovery due to three possible causes. First, oil has already moved to the southeastern part along the uplifted zones. Second, oil has never been generated because the organic matter of source rock is kerogen Type III, and the last possibility is that generated oil has been converted into gas by thermal overcooking.

References

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Simulation Results

Sequence | Lithology | Maturity | Facies

-16.5 Ma

-13.8 Ma

-10.5 Ma

-8.2 Ma

-6.3 Ma

-1.9 Ma

Present

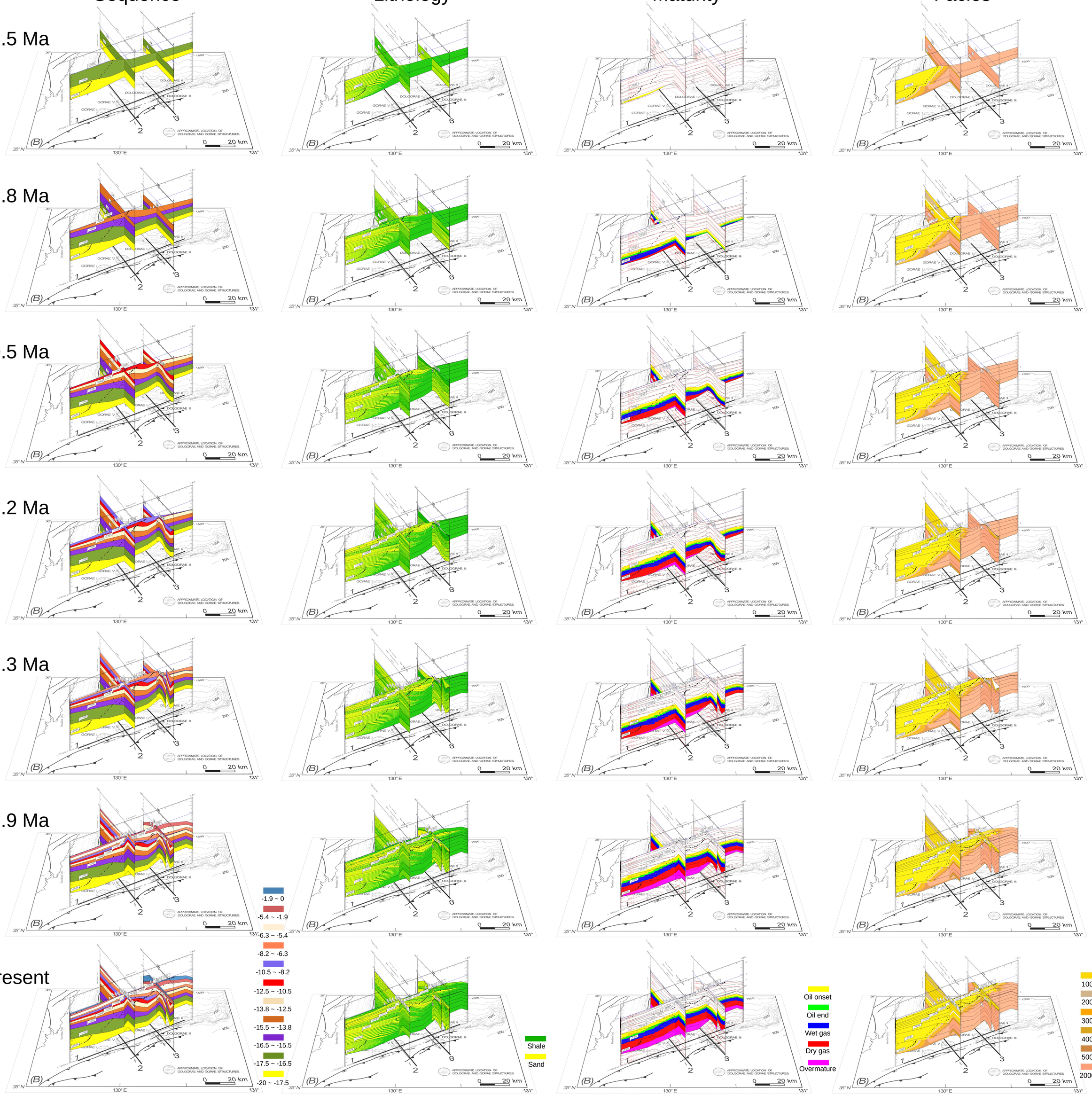

Fig. 5. Simulation result shows the evolution of sedimentary sequence, lithology, maturity and facies.