The formation and evolution of northeastern ends of the ECSSB, South Sea Korea, and its significance for petroleum exploration

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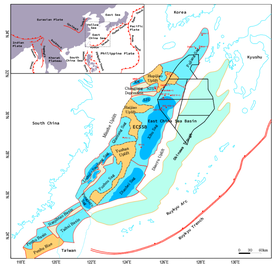
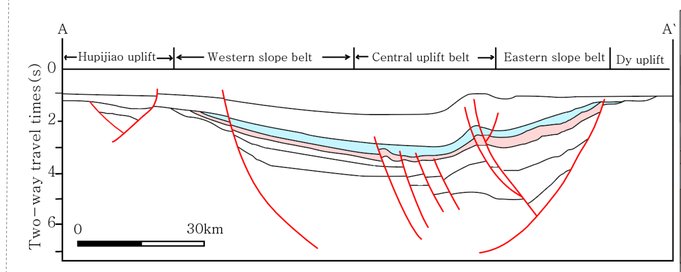
Ⅰ. Introduction

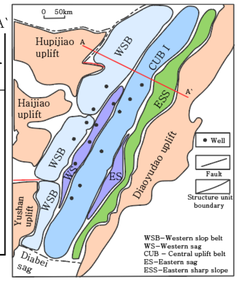
The South Sea of Korea has three offshore concession blocks between Korea and Japan, which has been considered as a back-arc basin. These area has complex evolution history because of successive subduction of the Paleo-Pacific (Izanagi) plate, Pacific plate, and Philippine plate. The tectonic characteristics of the area is subdivided into three domains: (1) Western Slope belt, (2) Central Uplift belt, and (3) Eastern Slope belt. The structural evolution of this area is reconsidered based on the reinterpretation of seismic and well data, which will provide better understanding on the tectonic evolution history that might help to understand tectonic evolution and hydrocarbon system of the area.

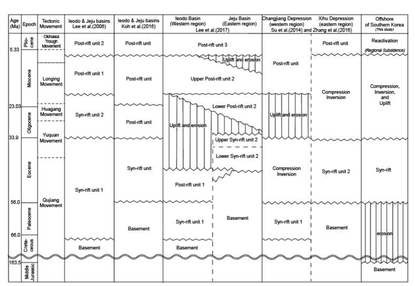
The East Chins Sea Shelf Basin (ECSSB) was initially developed as back-arc basin over the over-siding Paleo-Pacific (Izanagi) plate, and experience complex tectonic history by successive subduction of the tectonic plates including the Izanagi plate, the Pacific plate, and the Philippine plate since Late Cretaceous in age. After that, Izanagi plate ridge was subducted during Paleocene to Eocene, and the present-day Philippine plate under the Pacific plate. Several compression, inversion and uplift were occurred during the regional tectonic evolution followed by the development of a regional in the Middle Miocene.



[modified after Zhu et al., 2010]







Ⅱ. Seismic Interpretation

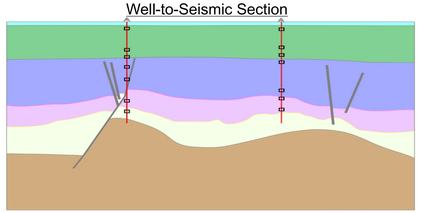
Seismic lines and well data are reinterpreted in terms of admissible fault geometries using seismic lines and well data, supported by KNOC (Korea National Oil Corporation), following recent structural concepts. We have used the Petrel S/W, donated to Yonsei University, considering reported basin-type and tectonic evolution data to investigate the tectonic evolution of the offshore South Sea of Korea.

Horizon interpretation has been done based on 2D and 3D seismic as well as data from seven wells. The unconformities representing key horizons were controlled by well data supported by regional geology. In addition, the interpreted acoustic basement is characterized by a dim-out in amplitude and chaotic characteristic. The acoustic basement of the Middle Jurassic in age is controlled by well data.

Representative Well Information

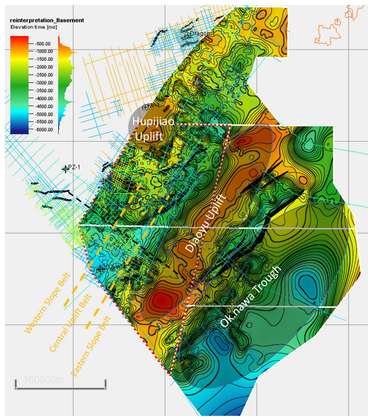
Horizons	TWT	MD
Pliocene	95.43	108.30
Middle Miocene	1114.18	1105.00
Late Oligocene	2006.16	2430.00
Late Eocene	2294.08	3010.00
Acoustic Basement	-	-

Well-to-Seismic Section

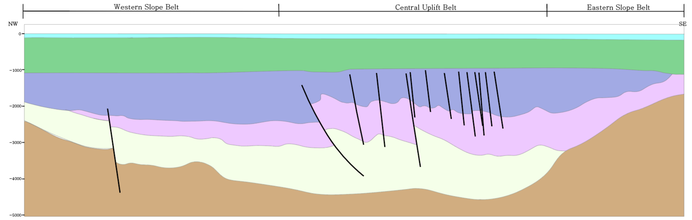


Ⅲ. Structural Interpretation

Structural seismic interpretations have been done to tackle tectonic evolution of the South Sea of Korea. The results indicate subdivided into three regions: (1) Western Slope Belt, (2) Central Uplift Belt, and (3) Eastern Slope Belt. The Western Slope Belt shows wider and more gently dipping than the Eastern Slope Belt, while the Central Uplift Belt is more complex tectonic features. These subdivision is similar with those of the south and central ECSSB, although the structural characteristics are different in different localities. It indicates that the study area is can be assigned into northeastern ends of the Xihu sag of the ECSSB.



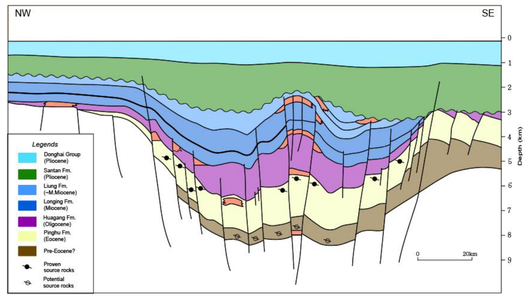
Based on the interpretation 2D and 3D seismic data, it seems that there is evidence of inversion structure and reverse faults in the study area. These features may have developed during the Late Oligocene. The study also suggests that after the Middle Miocene, the inversion might be related to the reactivation along the pre-existing structures. This implies that the tectonic evolution of the offshore South Sea of Korea is complex and involves multiple phases of deformation and structural reorganization.



Ⅳ. Petroleum System & Basin Restoration

ECSSB as a petrolic basin has been studied during several decades, with petroleum system and play concepts. The main play concepts of the ECSSB are developed in the Western Slope Belt and Central Uplift Belt in structural geology perspective including structure-stratigraphy and structural trap geometries. These play concepts might be potential to consider in the study area, although new play concept and complex petroleum system of the study area should be further investigated. Preliminary structural restoration using MOVE S/W donated by Petroleum Experts Limited show sequential developments of faults and folds that affect locations of paleo-basement uplift area that might help to study structural geometric interpretation of the study area.

Schematic Diagram for Play Concepts of the ECSSB



[modified after B. Wang et al., 2019]

Restoration