



**Day: Thursday 27 April**  
**Time: 2:15pm**

**Session: 7**

## **A Unique Post-MMU Hydrocarbon Charge System in the Bunguran Trough: A Case Study from Deepwater Sarawak and Implications for Petroleum Exploration**

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Bunguran Trough is an intra-continental basin located in the deepwater setting of the Rajang Delta, offshore Sarawak., Malaysia. The Trough is characterised by deepwater clastic deposition of post-MMU (Middle Miocene Unconformity) sediments. The pre-MMU sediments are at present deeply buried to more than 6,000m due to the rapid subsidence history of the Bunguran Trough and high clastic influxes of post-MMU sedimentation (Figure 1). The main exploration risk in the study area remains the presence of well-developed reservoirs. However, hydrocarbon charge risk represents another challenge to address due to the poor geological understanding and limited exploration drilling in Bunguran Trough. Conventionally, the coals and carbonaceous shales of the pre-MMU Cycles I/II sequences, similar to those encountered in the Balingian Province are considered as the key source rock intervals in Bunguran Trough. This paper attempts to address the charge risk based on the geochemical investigations conducted in the study area.

In the pre-drill exploration phase, a seabed geochemical survey was conducted to investigate the hydrocarbon potential of the study area. The results confirmed active thermogenic hydrocarbon seepages and indicated the presence of an active hydrocarbon charge system generating from mature source rocks; currently ranging from oil- to gas-matured from the post-MMU interval; instead of the commonly believed pre-MMU coaly source rocks, which are well over-matured at present-day. The results suggest the presence of a relatively young post-MMU charge system in the study area. This working hydrocarbon charge model from the post-MMU mature source rock interval is later vindicated by the recent results of well “T-1” drilled in the Bunguran Trough, which confirmed a thermogenic hydrocarbon charge had migrated into the tested structure with the dominant fluid type being wet gas, based on mud-gas isotope data and real-time fluid logging and analysis (FLAIR).

One of the potential source rock intervals, currently matured for hydrocarbon generation in post-MMU sequences is from the Lower Pliocene section, which is also observed in a nearby well tested earlier. To assess the hydrocarbon charge system in the study area and the timing of charge relative to the formation of the structures, an in-house basin modelling study was conducted using the Lower Pliocene source rock as the key generating interval. The modelling outcomes are consistent with the actual well results and validated gas and potential oil charges from the modelled Lower Pliocene source rock. Nonetheless, the basin modelling study also indicated that source rock maturation is another uncertain geological risk that needs to be carefully assessed, especially in the north and north-eastern parts of the study area (Figs 2 and 3). Moreover, the distribution and the lateral variation of the source rock properties of this Pliocene petroleum system are still poorly understood due to the lack of the penetrated source rock data covering the study area. Further drilling outcomes in the Bunguran Trough, where available should therefore be incorporated to update and to better improve our understanding of this unique post-MMU hydrocarbon charge system and its implications for the post-MMU exploration potential of deepwater Sarawak.

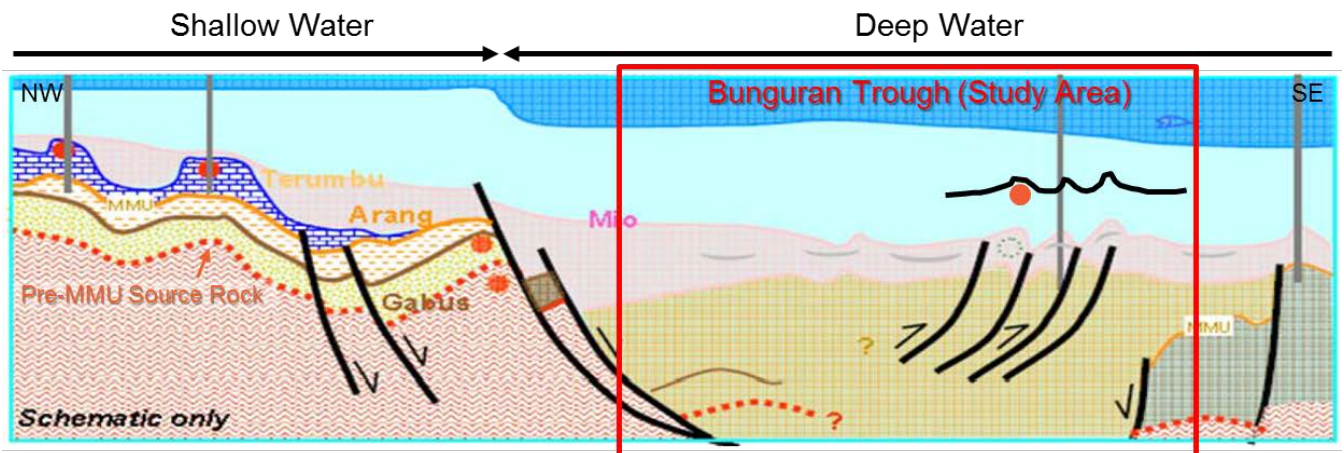


Figure 1: Schematic section showing hydrocarbon charge systems in Offshore Sarawak.

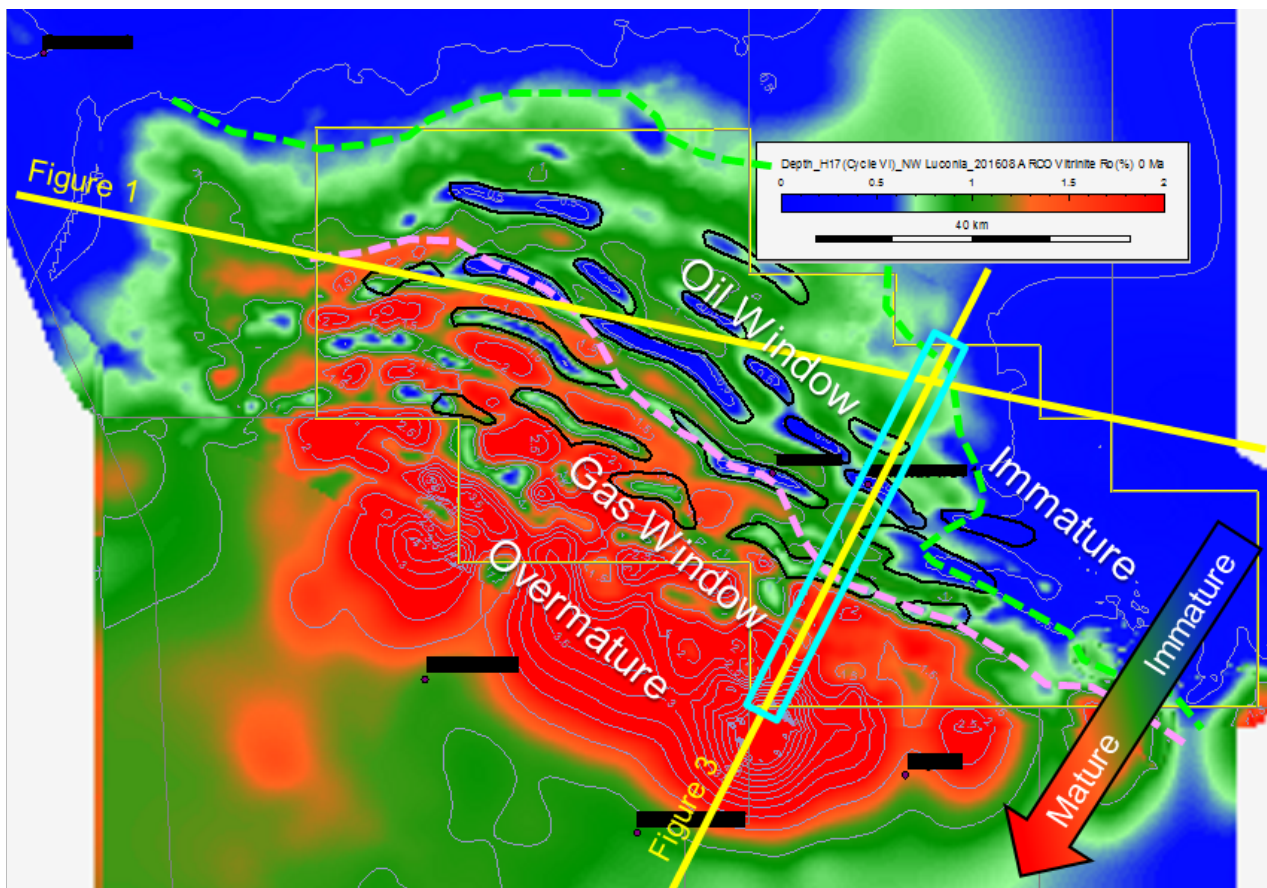


Figure 2: Maturation map for Lower Pliocene source rock.

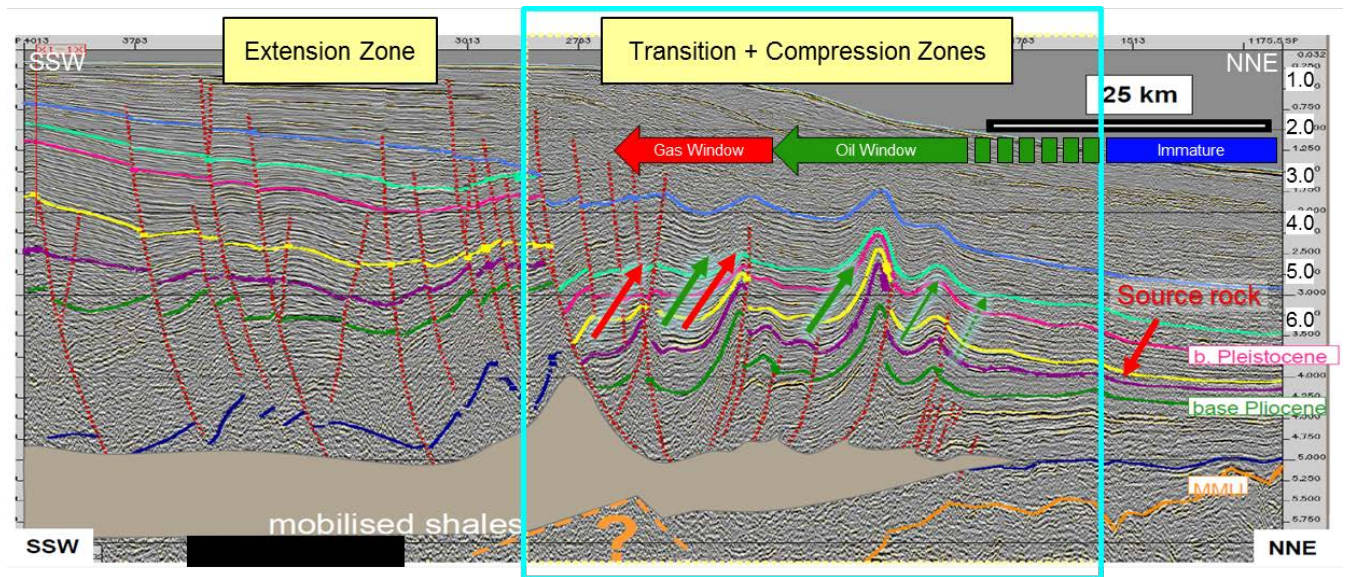


Figure 3: Regional cross section across the Bunguran Trough.

### Speaker Biography

Kazuhiro Ogawa received his MSc in Geology from Tohoku University, Japan in March 2012. He joined JX Nippon in April 2012 as a Geologist in Japan, and currently is working in JX Nippon Kuala Lumpur Office since 2013 for deepwater exploration projects in Malaysia. He has experiences of seismic interpretation, basin modelling, petrophysical analysis, resource assessment and prospect maturation; and was involved in wellsite geology work on the rig, CSEM operation and seabed geochemical survey. His research interests include basin modelling integration with reservoir fluid geochemistry, mud-gas isotope and surface geochemistry. His recent work has mainly focused on the petroleum systems of deepwater thrust-belts in offshore Sabah and Sarawak, Malaysia