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ORAL PRESENTATION

Physics and Biology of Biogenic Gas Plays: Implications for SE Asia

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This century has seen a surge in biogenic gas discoveries worldwide, particularly in deepwater settings, with fields being found of much larger scale than previously. This trend is represented in Southeast Asia by the Rakhine Basin discoveries, while other global examples include the Levantine and Zohr discoveries in the Eastern Mediterranean. Many such discoveries lie deeper than previous biogenic gas finds and at temperatures exceeding that of the biogenic window (Figure 1).

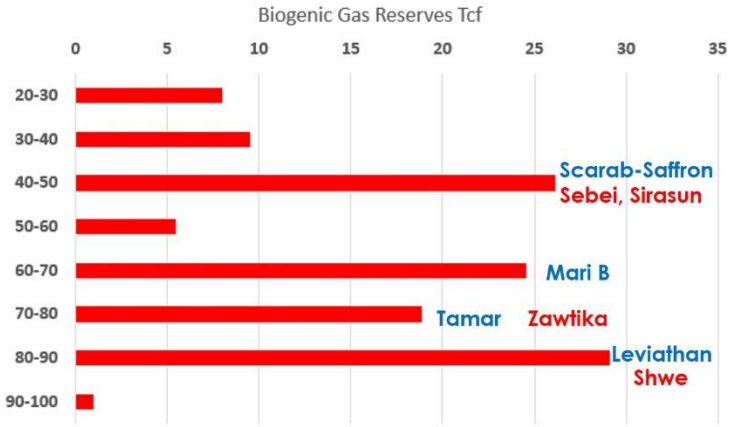

Figure 1. Global Biogenic Gas reserves, (excluding mixed systems in West Siberia, Caspian and GOM, plotted by reservoir temperature (deg C). SE Asia fields labelled in red, Eastern Mediterranean in blue

Biogenic gas plays in SE Asia (Figure 2) had previously attracted relatively little attention, with the region often viewed as generally unfavourable for their development due to high surface temperatures and high geothermal gradients. Study of the few small to moderate sized biogenic gas occurrences previously found in the region appear to confirm such a view for most onshore and shallow marine settings, including provinces in East Java, Indonesia and Qaidam, China. PVT data from these provinces illustrate constraints that confine the biogenic window to shallow intervals where the gas expansion factor is low and seals are often under-compacted.

It is shown here, with reference to the Rakhine Basin of Myanmar and the Eastern Mediterranean, that the evolution of PVT (Pressure-Volume-Temperature) conditions in deep water (both at the time of sediment deposition and at present day) are considerably more favourable to the development of multi-Tcf biogenic gas fields. This results not only from the lower seabed temperatures and geothermal gradients that characterize these regimes, but also from the effects of the increased pressure imposed by a water column. A key constraint to date on shallow water biogenic plays has been that generation is shut off at around 60-70° C, below which the volume of gas can be expected to shrink with increased pressure. The proportional rate of shrinkage however declines with increased pressure, so this is far less of a concern in deep marine settings. This can be illustrated with reference to the PVT History of the deepest pools of the Shwe Field (Figure 3).

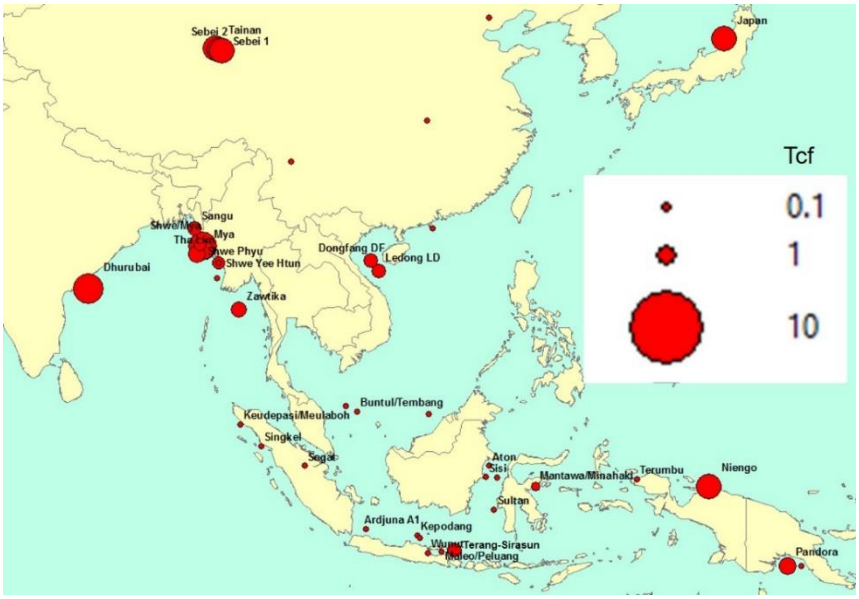

Figure 2. Biogenic or mixed biogenic-thermogenic gas fields of the Asia-Pacific region

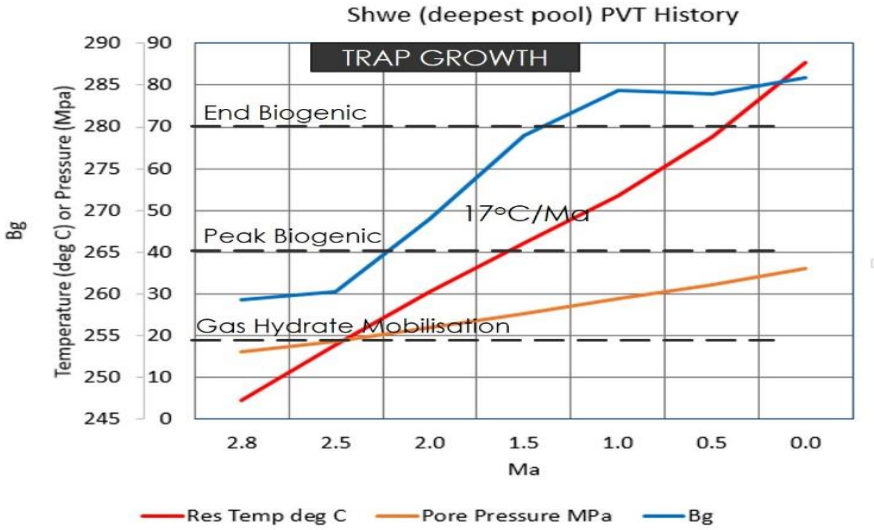

Figure 3. Interpreted PVT and petroleum system history of the deepest pool of the Shwe field. Bg = gas expansion factor, controlling compression of the gas pool after generation has ceased.

A matrix is developed here from study of the working analogues for evaluating the potential for undiscovered biogenic gas systems in SE Asia, which will be demonstrated for some of the generally colder basins of eastern Indonesia and Papua New Guinea. Key factors include:

a. The occurrence of thick series of type iii kerogen bearing sediments, e.g. in a prodelta.
b. Development of anoxia and/or heating rates of 3-25 ◦ C/Ma.
c. Under-compaction of sediments with pore spaces large enough to accommodate bacteria.
d. Low surface / seabed temperature (as in deepwater) and/or geothermal gradients under 25 ◦ C/km.
e. Deposition in a highly pressured deep marine setting.
f. Development of traps at a very early stage after deposition, particularly syn-sedimentary compressional antliclines, associated pinchouts and carbonate build-ups.
g. Development of a reasonably compacted seal soon after deposition.