

Seals and Leaks in Dynamic Petroleum Systems: The East Java Sea, Indonesia and the Timor Sea, Australia

By

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The East Java Basin, Indonesia, the Timor Sea, and the Yampi Shelf of the North West Shelf, Australia, are examples of dynamic petroleum systems where the processes of hydrocarbon generation, expulsion, migration, accumulation, and leakage are occurring today. Understanding the importance and relative balance of some or all these processes is a key step in reducing exploration uncertainty. In particular, seal effectiveness is a key factor controlling the prospectivity of traps within these petroleum systems.

The seals in the East Java Basin are dynamic, rather than absolute, barriers to fluid flow. Empirical and experimental data from the largest producing gas field in the region, Pagerungan, suggest that it is a dynamically filling and leaking capillary trap, which may have been volumetrically larger at some time in the past.

In the Timor Sea, Neogene tectonism has caused both extensional faulting and basin formation. The faulting caused the partial to complete breaching of many of the traps in the region, whereas the subsidence in the newly created Neogene depocenters was the drive for a renewed phase of hydrocarbon expulsion and migration consisting principally of gas. In traps with high seal capacities, this charge of gas flushed preexisting oil accumulations. In other cases, completely breached traps were refilled with gas over periods as short as perhaps 2–3 m.y.

On the Yampi Shelf, dry thermogenic gas is migrating actively across the shelf. Leakage rates to the sea floor are high, particularly as the regional seal thins against basement highs and as the seal becomes thinner and sandier toward the margin. The risk of gas flushing of low-relief, oil-bearing traps in this area is ameliorated somewhat in a zone where seal capacity is low for gas (favoring gas leakage), but adequate for the sealing of oil.