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Impact of an Evolving Geological Model on the Dramatic Increase of Gas Reserves in the Mahakam Delta: The Peciko Case History

The Peciko field is located in the prolific Kutei basin (Indonesia, East Kalimantan), southward of the supergiant Tunu gas field, in water depths of around 40 meters (Figure 1). The field produces gas from Upper Miocene deltaic reservoirs. The lithology comprises a repetition of superimposed deltaic cycles (average thickness in the range of 30 – 50m). The main pay zone of the Peciko field consists of a stacking of delta front mouth bars. Based on flooding surfaces, the upper Miocene has been subdivided into eight main intervals (MF2-3 to MF8-9). Later additional intervals have been proposed related both to stratigraphy and pressure data.

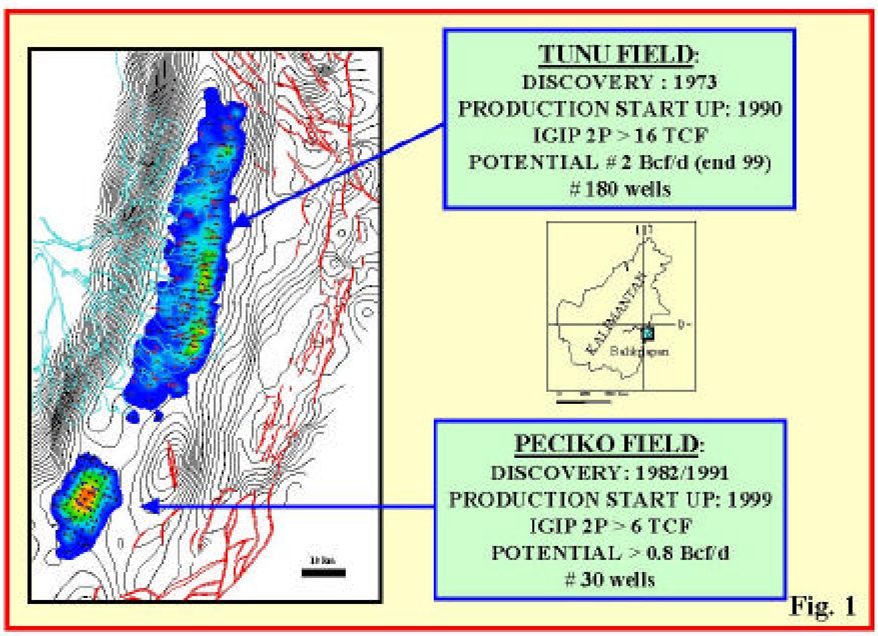
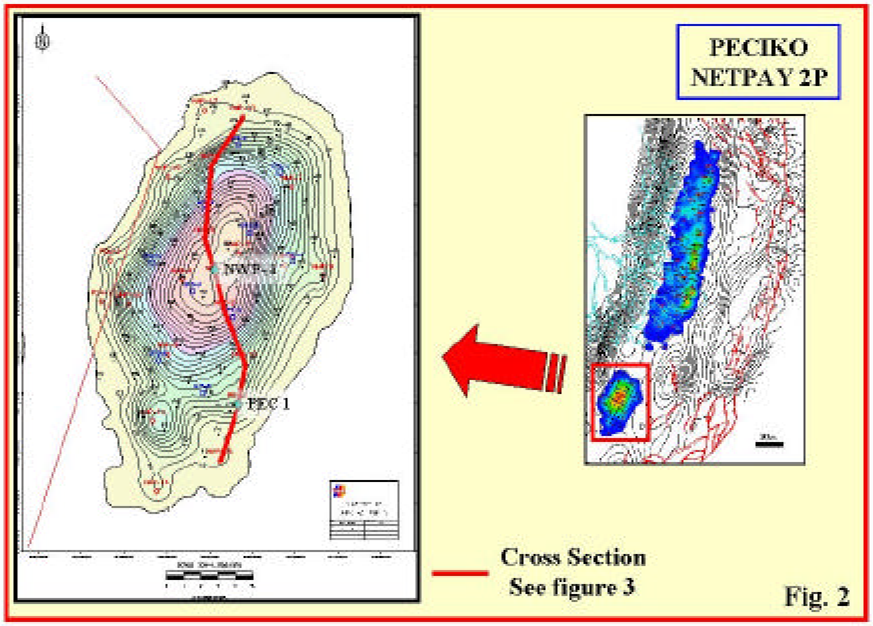


Fig. 1

The main kitchen involved in the sourcing of the Tunu-Peciko gas fields lies in the syncline axis located to the west. The main source rocks in the area are composed of organic-rich shales (gas prone) associated with the tidal deltaic plain and deltafront (no coal). Hydrocarbon generation began three million years ago and is still active today.

The first exploration well (Peciko-1), drilled on the top of a deep-seated structure in 1982, tested only marginal gas pay above the structural closure. It was not until 1991, however, that the giant gas accumulation was actually tested. Clastic influx from the north was already surmised prior to drilling and a stratigraphic play concept had been worked out. The NW

Peciko-1 (NWP-1) well was then drilled in the early 1991, 6 km north of the initial test well along the crest of the structural nose (Figure 2).



This success followed the conclusions and recommendations of a comprehensive regional study that stressed the potential trapping role of facies variations occurring between the shelf and the shaly overpressured prodelta.

The following appraisal drilling campaign and the intensive associated pressure measurements program (more than 2000 RFT/MDT measurements) induced a comprehensive geological model (with stratigraphic and hydrodynamic expressions) for this complex multilayered field (Figure 3). It consists of a 36 layer model, vertically isolated by seals (shales due to 5^{th} order flooding events). Each layer is 40m thick in average, it roughly corresponds to the individual thickness of a deltaic cycle as previously defined. Within each of these layers, the pressure regime is homogeneous since the reservoirs are connected. The gas in communication with the acquifer to the North/Northwest is in hydrostatic conditions. The gas located within disconnected sands to the South/Southeast is in overpressure conditions. The lateral extent of the individual gas accumulation is not only related to the shale-out and to faults (no faults are observed in the field), but is also controlled by hydrodynamic factors related to rapid burial. A deep hydrodynamic system evolved in which the flow of compaction waters towards the more proximal, lower pressured deltaic deposits, was forced along the stratigraphy by regionally extensive shale layers.

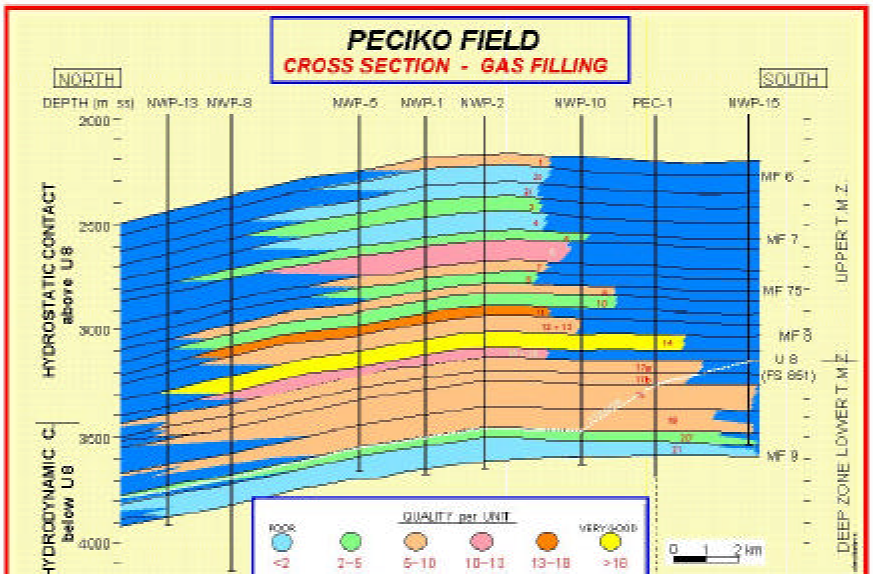


Fig. 3

This model and methodology developed for Peciko was later evolved significantly and applied to the neighboring Tunu field, contributing to the understanding of this supergiant field (more than 16 Tcf [2P] reserves) and extending its limits, both laterally and vertically, well beyond those of the initial recognized accumulation (Figure 4).

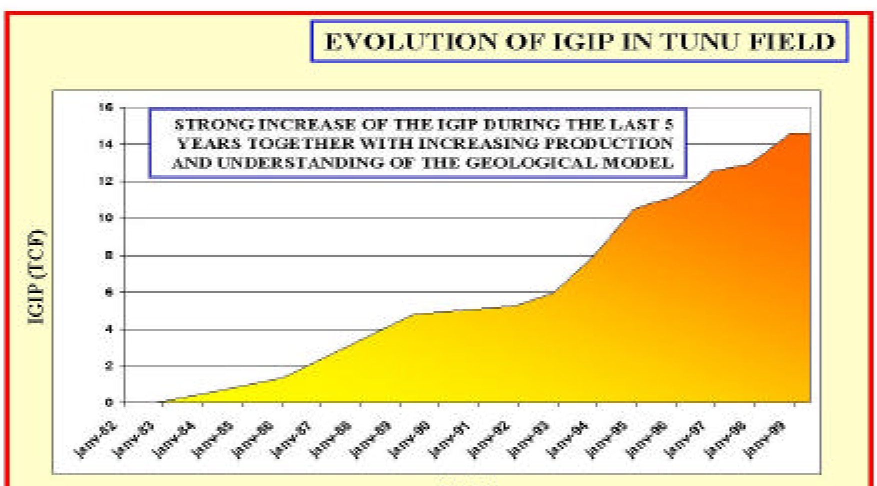


Fig. 4

More than 6 Tcf (2P) of reserves are estimated to be present in the Peciko field. The production (around 0.8 Bcf/day) started in October 1999 using two platforms which increased the Peciko - Tunu potential up to close to 3 Bcf/day. This confirms their major long term contribution to the largest liquefaction plant in the world (Figure 5).

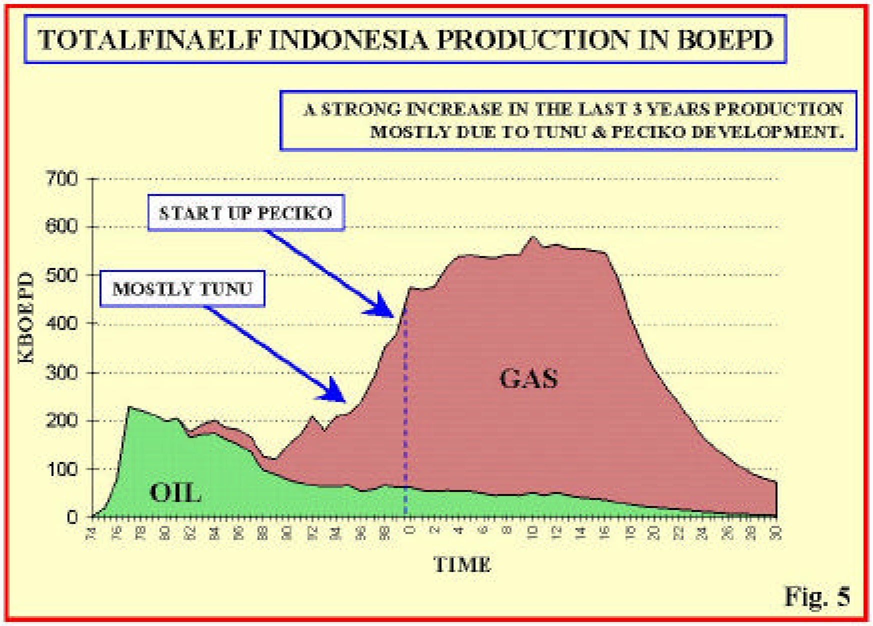


Fig. 5

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