

Paper 17

Angsi Group K gas resource appraisal and development challenges

MOHD TAHIR, ZAINUDDIN YUSOFF, DAVID E. NICE AND CHUA HWA TIAN

**Esso Production Malaysia Inc.
Kompleks Antarabangsa
Jalan Sultan Ismail
50250 Kuala Lumpur**

Angsi Field, a gas discovery in the Southern Malay Basin, has one-half of its gas resource in compartmentalized and low permeability Group K sandstone reservoirs. Average

porosity in the K is 12 percent with a permeability of 0.7 millidarcies. Production tests conducted on the first two exploration wells flowed at rates which are considered non-commercial. The Angsi K reservoirs also exhibit vertical and horizontal compartmentalization. Vertical compartments are defined by intraformational shale layers which separate K sands into downward increasing pressure compartments. Horizontal compartments are defined by lateral facies changes and fault segmentation. The lateral facies changes are confined to the base of sand packages where braided stream deposits have cut down into mud rocks isolating the basal sands from hydrocarbon migration. Fault segmentation has created additional barriers to migration into some segments of the structure. Although the faults appear to be discontinuous by 3D mapping with throws rarely exceeding the thickness of the K sands, the faults must be sealing because of different fluid contacts across fault planes with apparent sand to sand juxtaposition.

Despite these complexities, the K reservoirs remain a sizable resource and efforts were made to test for increased deliverability through fracture stimulation. The results of a propped hydraulic fracture stimulation performed on Angsi-4 were encouraging with a four-fold increase in initial gas production rate. A good, commingled, post-frac production rate was achieved from three Group K reservoirs. Further studies such as full-field and single well reservoir models, in addition to fluid and special core analyses, are being conducted to aid in determination of ultimate gas recovery and to aid in field development plan optimization.
