Fractured Carbonate Reservoir of Tiaka Field, Eastern Sulawesi, Indonesia (T-3 Carbonate Cores)*

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Field Characteristics

• Discovered: 1985
• Play Type: Miocene Thrust Structure
• Reservoir: Miocene Carbonate of Tomori Fm.
• Reservoir depth: 6800-8700 ft TVDSS
• Total wells: 10 wells
• Avg Por & Perm: 7 % & 5 md
• Type Hydrocarbon: Oil
• Initial Pressure: 3776 psi
• Current Production Rate: ~1500 BOPD (from 6 wells)

Stratigraphic Requisites for Accumulation:

Source Rock
• Lower-middle Miocene Tomori Formation
• Middle Miocene Matindok Formation

Reservoir
• Lower-middle Miocene Tomori Formation
• Middle-upper Miocene Minahaki Formation and
• Upper Miocene-Pliocene Mantawa Member
Seal
• Middle Miocene Matindok Formation
• Pliocene Kintom Formation (Sulawesi Group)

Summary

• Structural trap in the Tiaka Field is characterized by NE-SW low-angle thrust fault.
• Reservoir characteristic is tight, fractured carbonate reservoir dominated by muddy facies.
• The depositional environment of this carbonate is interpreted as shallow restricted marine environment.
• Evidence of fractures can be identified and interpreted from core, log, thin-section and well-test data.
• Fracture distribution and characteristic modeling utilized conceptual approach controlled by well data.
• The image log run in T-7ST2A indicates that the dominant orientation is to the NW-SE with a mean of fracture dip of 30°-40° toward the southwest.
• T-3 Core Summary
  o Quality is generally poor (only the dolomitized zone displays moderate- good quality).
  o Coral reef facies are poorly developed.

Reference

FRACTURED CARBONATE RESERVOIR OF TIAKA FIELD, EASTERN SULAWESI, INDONESIA
(T-3 CARBONATE CORES)

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Outline

• Introduction
• Regional Geology
• Fracture Identification
• Summary
Field Location

TIAKA AREA
Tiaka Field Summary

- Discovered: 1985
- Play Type: Miocene Thrust Structure
- Reservoir Objective: Miocene Carbonate of Tomori Fm.
- Reservoir depth: 6800 – 8700 ft TVDSS
- Total well drilled to date: 10 wells
- Average Por & Perm: 7 % & 5 md
- Hydrocarbon: Oil
- Initial Pressure: 3776 psi
- Current Production Rate: ±1500 BOPD (from 6 wells)
Tectonic Setting and Regional Structure
Regional Stratigraphy

**Source Rock:**
- Tomori Formation
- Matindok Formation

**Reservoir:**
- Tomori Formation
- Minahaki Formation and Mantawa Member

**Seal:**
- Matindok Formation
- Kintom Formation (Sulawesi Group)

Pertamina BPPKA, 1996
Seismic Section

Core of T-3

Tomori
3D Fault Model

Tiaka Fault
Depth Structure Map of Top Tomori Fm.
Fracture Distribution Model

- Proximity to faults
- Maximum Curvature
Fracture Identification

- Core
- Thin Section
- Well-log Data
- Well Test Data

Direct Detection
Indirect Detection
Fracture in Core Sample

Fracture evidence in Core of T-3
Fracture in Core Sample

Fracture core observation for fracture width measurement

Fracture Width T-3

Fracture Width T-4

The probability of fracture width taken from core T-3 & T-4
Light to medium grey wackestone and packstone consisting of foram, echinoderm and gastropod. Extensive fractures sub-parallel to core axis are generally calcite-filled, suggesting restricted shallow marine environment.
Fracture in Thin Section

Fracture filled by calcite & cut by fracture porosity (T-2)

Vug & fracture porosity (T-4)

Fracture cross-cuts a skeletal fragment, intraskeletal cement and matrix, indicating that fracture event post-dated lithification & void-filling cement (T-2)

Fracture porosity, dolomitization (T-3)
Fracture Property in Well-log

Fracture evidence in the Tomori limestone is indicated by cross-over between apparent porosity and sonic porosity, consistent with core and thin-section descriptions.
Fracture Evidence in Image Log (T-7St2A)

Example of natural open (conductive) fracture (blue fracpole)

Stereo-plot representing all natural fractures in the well having dominant NW-SE strike (orange solid) and a secondary NE-SW strike (Orange dashed)
Well Test Data & Production Profile

$\omega : 0.9$

The Oil production is sharply declined and unstable

Tight Carbonate fractured reservoir
T-3 Carbonate Facies

- **8787’-8800.5’**: Coral Framestone and Interbedded Floatstone
- **8800.5’ - 8814.5’**: Intensely Fractured Lime Wackestone
- **8811’, 8847’, 8892’, 8920’**: Coal
- **8814.5’-8830’; 8849’-8891’; 8947’-8969’**: Bioturbated Lime Mudstone & Wackstone
- **8830’-8846’**: Partially Dolomitized Wackestone & Packstone
- **8893’-8947’**: Graded Lime Packstone & Wackestone w/ Interbedded Coals
- **8969’- 9010.5’**: Argillaceous Stylolitic Lime Wackestone & Packstone

Slickensides in the Kintom caused by Tiaka Thrust Fault.
Depositional Environment

- The majority of cored sequence is composed of carbonate lithologies of mudstone-wackestone with streaks of coals and shale.
- Carbonate sequence deposited in the very shallow restricted marine environments as shallow lagoon and tidal flat that allowed periodic exposure of vegetation resulted in coals of both in situ and transported origins.
- Cycle sediment of lagoon and tidal flat sequence with vegetation is interpreted as an indication of intermittent transgressive and regressive episodes.
Summary

- Structural trap in the Tiaka Field is characterized by NE-SW low-angle thrust fault
- Reservoir characteristic is tight, fractured carbonate reservoir with muddy facies dominant
- The depositional environment of this carbonate was interpreted as the shallow restricted marine environment
- Fracture evidence can be identified & interpreted from core, log, thin section and well test data
- Fracture distribution and characteristic modeling used conceptual approach controlled by well data
- The image log run in T-7ST2A indicates that dominant orientation is to the NW-SE with a mean of fracture dip of 30°–40° toward southwest
- T-3 Core Summary:
  - Quality generally poor (only the dolomitized zone displaying mod- good quality)
  - Coral reef facies are poorly developed