Tight Gas Reservoirs
R&D Project Approach

EBN – TNO Tight Gas Symposium
Utrecht, September 19, 2006
Tight Gas Reservoirs: some definitions

Applies to the sandstone and carbonate reservoirs, with all type of geometry (thick, multi-layer, fractured,...) and all types of traps (structural, stratigraphic, deep basin,...)

- **Matrix Permeability**:  
  \[ 1 \mu D \text{ to } 0.1 \text{ mD} \]

- **Porosity**:  
  \[ 3-5\% \text{ to } 15-20\% \text{ (effective)} \]

- **No or limited natural flow**:  
  \[ \text{Typically the initial flow before stimulation is less than } 0.5 \text{ MMscfd (} \sim 15.000 \text{ Sm}^3/\text{d)} \]
Tight Gas Reservoirs: why a R&D Project?

• The Technical challenge
  - various tight sands fields which are difficult to develop

• The Reserves challenge
  - Reserves replacement is the key challenge for the O&G Industry, particularly because of ambitious growth objectives
  - Access to “conventional” Reserves is getting difficult
  - Develop Tight Gas Reservoirs is one of the ways to face the reserves challenge

⇒ Consolidation of Know-How is a driver
Tight Gas Reservoirs R&D Project: Problematic

- **IDENTIFICATION**
  - Basins characterization
  - Structural and/or sedimentological heterogeneities identification
  - ...

- **EVALUATION**
  - Static reservoir evaluation ⇒ Coring, Logging
  - Dynamic reservoir evaluation ⇒ Testing
  - Reserves estimation
  - ...

- **PRODUCTION**
  - Optimize well architecture
  - Drilling performances (ROP)
  - Reduce formation damages
  - Fracturing
  - ...

Tight Gas EBN-TNO Symposium – Utrecht September 2006
Tight Gas Reservoirs R&D Project: Programme

• **Technical Studies** *with the Métiers*

• **Pilots** *with the Affiliates*

• **Partnership** *with Key Actors*
TGR R&D Project: Technical Studies

IDENTIFICATION

• GEOLOGY
  - Basin Scale and Field Scale:
    - Regional Geology setting & Reservoir review
    - Diagenesis impact and integration to regional setting
    - Natural Fracturing and Impact on Productivity in TGR

• GEOPHYSICS
  - Identification of heterogeneities ("Sweet Spot") mainly structural
    - Multi-azimuthal 3D seismic
  - Borehole seismic / X-well seismic (3D multi azimuth VSP) for natural fracture
  - FRAC monitoring / Production monitoring using Micro-seismic data analysis
TGR R&D Project: Technical Studies

EVALUATION

• PETROPHYSICS
  ▪ Measurements: Permeability and porosity, Swi and salinity, Compressibility effect, Capillarity pressure

• LOGGING
  ▪ Log measurement interpretation
  ▪ Fracture description using DSI+FMI

• WELL TESTING
  ▪ Well test data analysis in TGR
  ▪ WFT measurement
  ▪ Decline curve analysis

• RESERVOIR MODELLING
  ▪ Practical well modelling
  ▪ Permeability up-scaling
TGR R&D Project: Technical Studies

PRODUCTION

• WELL PRODUCTIVITY
  ▪ Well productivity model
  ▪ Water lift in fractured well

• HYDRAULIC FRACTURING
  ▪ Standardise practices
  ▪ Feasibility in horizontal wells
  ▪ Fluid characterisation and modelling of damage at the face of the frac.
  ▪ PEAs follow-up + US analogues + JIPs with Service C\textsuperscript{ies}
  ▪ Liquid blocking prevention
TGR R&D Project: Technical Studies cont’d

PRODUCTION

• GEOMECHANICS
  ▪ Stress anisotropy review
  ▪ Well stress model
  ▪ Stress in heterogeneous formation
  ▪ Validation of structural concept
  ▪ Hydraulic fracturing in natural fractured reservoirs

• DRILLING & COMPLETION
  ▪ Under balance drilling database review
  ▪ Casing design
  ▪ Completion review
TGR: Pilots

• IDENTIFICATION
  ▪ 3D Multi-azimuthal seismic
  ▪ Multi azimuth 3D VSP
  ▪ Frac monitoring using Micro-seismic

• EVALUATION
  ▪ SonicScaner

• PRODUCTION
  ▪ Water blocking
  ▪ Hydraulic fracturing: proppants, injected fluids
  ▪ Productivity Pilot
  ▪ Under Balanced Drilling
  ▪ Multi-lateral sub-horizontal drains
TGR: Partnerships

- Universities (Europe, US, Canada, China,...):
  - University of Texas (Austin)
  - UPPA (Pau)
  - Université de Bordeaux / CNRS
  - University of Alberta (Edmonton)

- Institutes and Laboratories:
  - IFP
  - Texas A&M (College Station) - Crisman Institute
  - FracTech
  - SCOTIA
  - OMNI
  - VIPS Ltd and Rockfield Software Ltd
  - CSIRO (Australia)

- Services Companies and/or other Operators
TGR R&D Project

THANK YOU FOR YOUR ATTENTION

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