

# **Tight Gas Reservoirs R&D Project Approach**

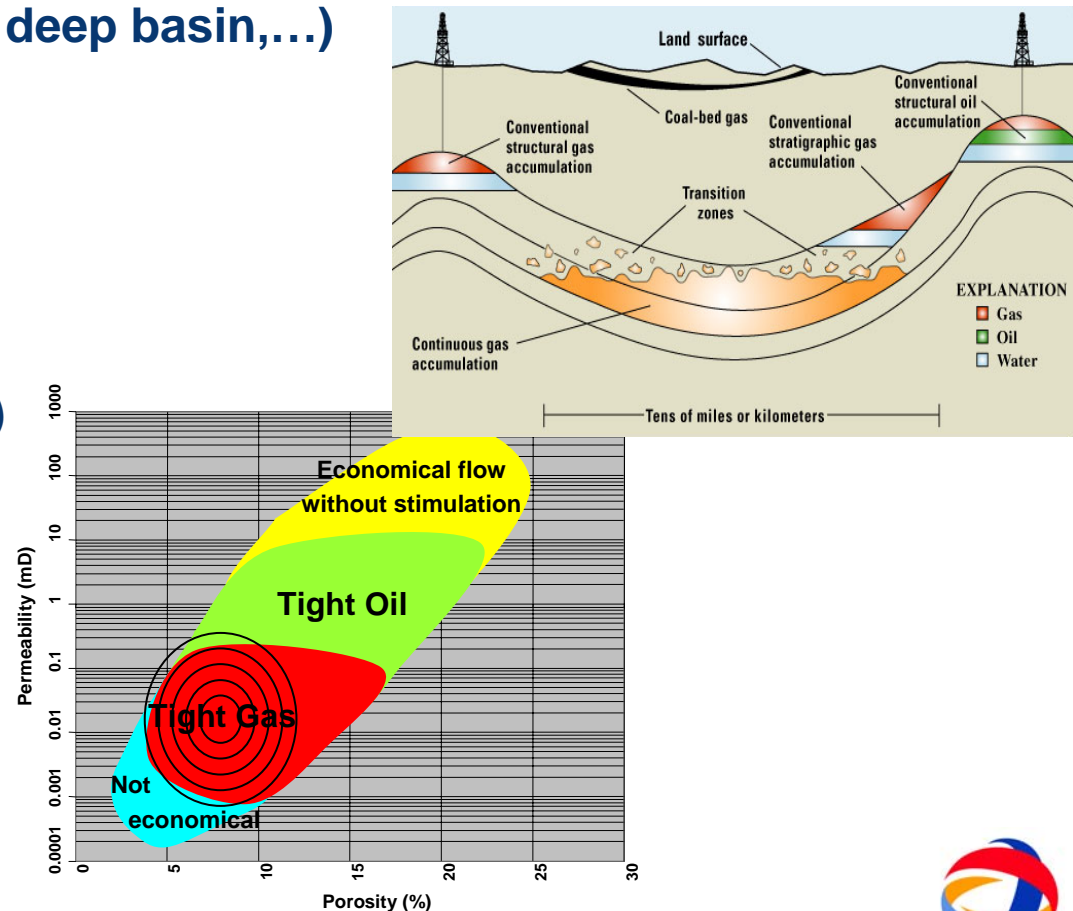
EBN – TNO Tight Gas Symposium

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,...)

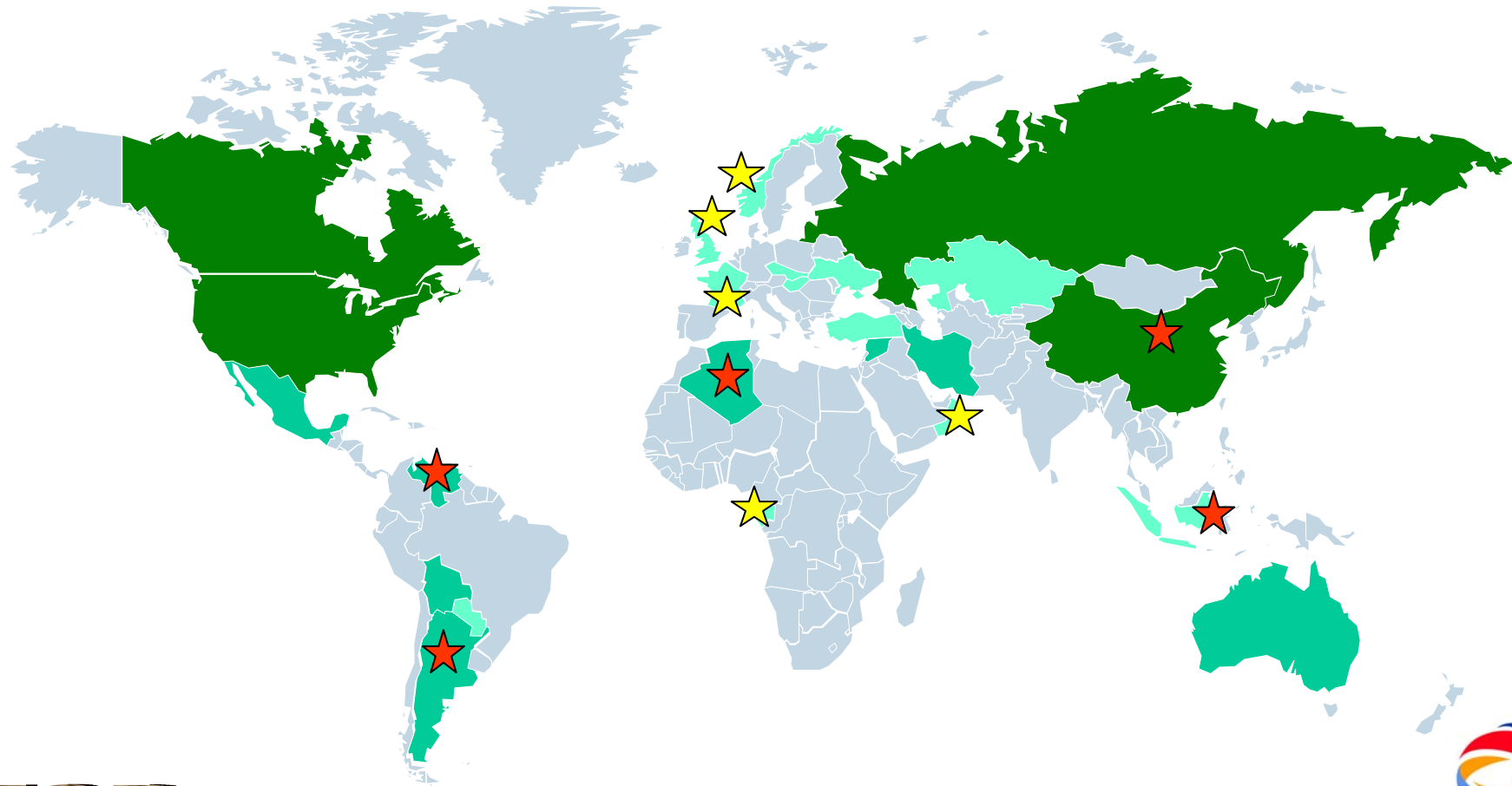
- **Matrix Permeability :**
  - ⇒ 1  $\mu\text{D}$  to 0.1 mD
- **Porosity:**
  - ⇒ 3-5% to 15-20 % (*effective*)
- **No or limited natural flow:**
  - ⇒ Typically the initial flow before stimulation is less than 0.5 MMscfd ( $\sim 15,000 \text{ Sm}^3/\text{d}$ )



# Tight Gas Reservoirs: why a R&D Project ?

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## Total's current portfolio



# Tight Gas Reservoirs: why a R&D Project ?

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- **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

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- **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 Reservoirs R&D Project: Programme

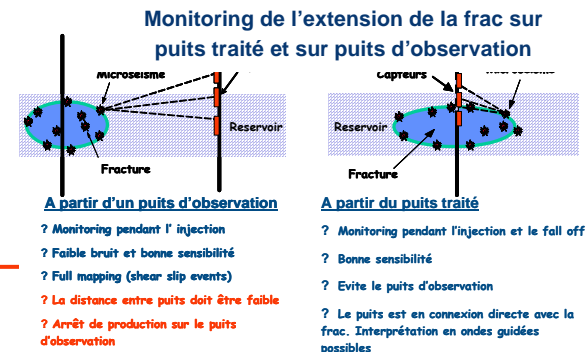
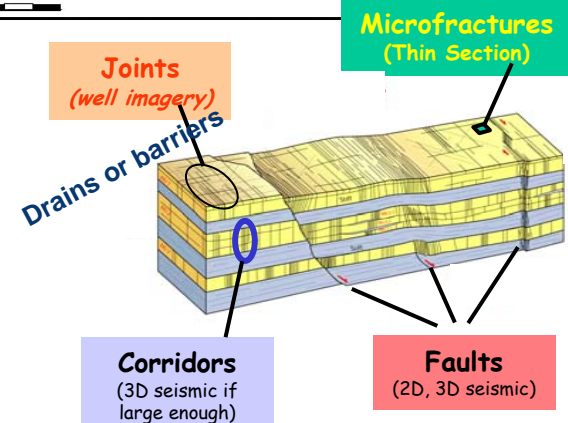
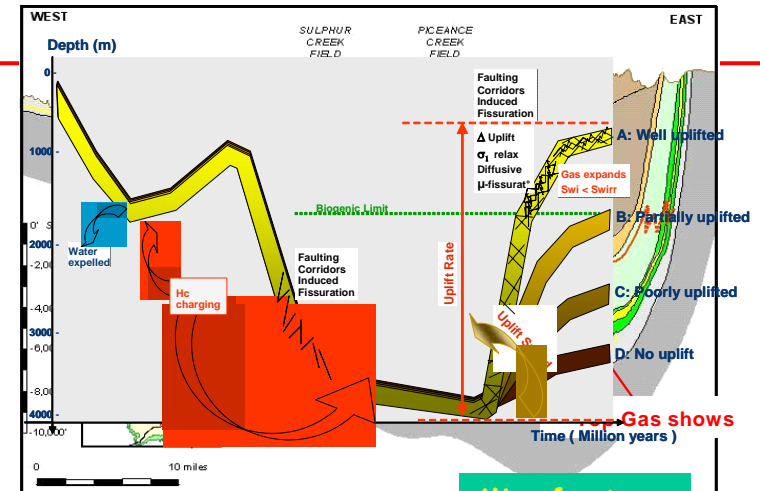
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- **Technical Studies** *with the Métiers*
- **Pilots** *with the Affiliates*
- **Partnership** *with Key Actors*

# 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**

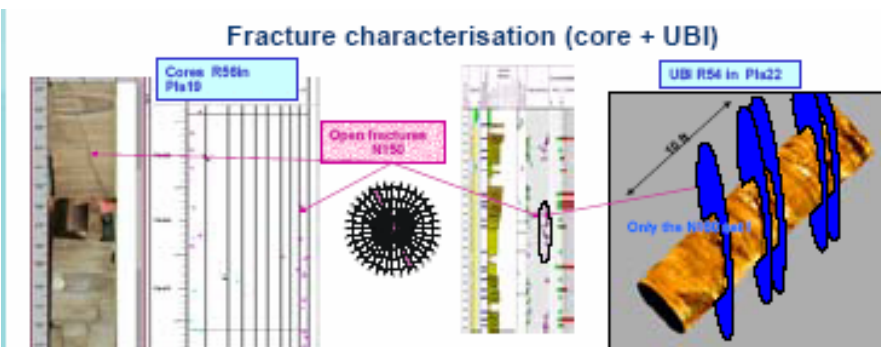


**TGR**

# 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



Interference test vs K

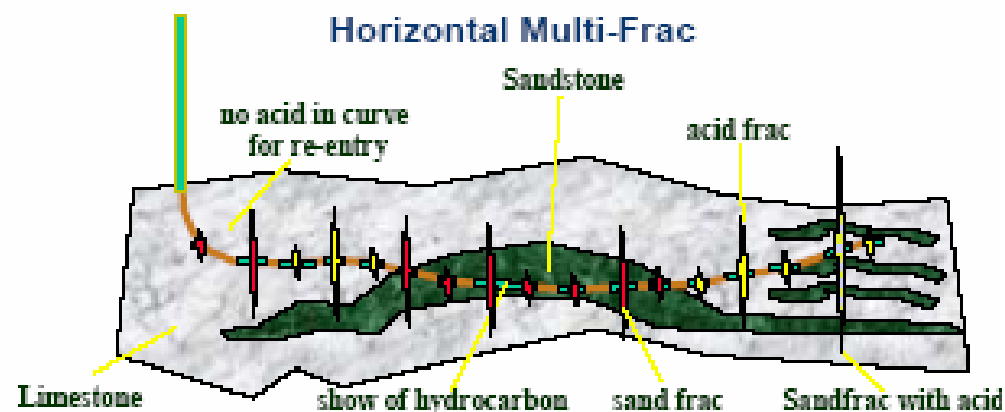
		Distance pulser observer	
		700 ft	1500 ft
K [mD]	1	18 days	83 days
	0.1	83 days	500 days
	0.01	830 days	5 000 days

**TGR**

# TGR R&D Project: Technical Studies

## PRODUCTION

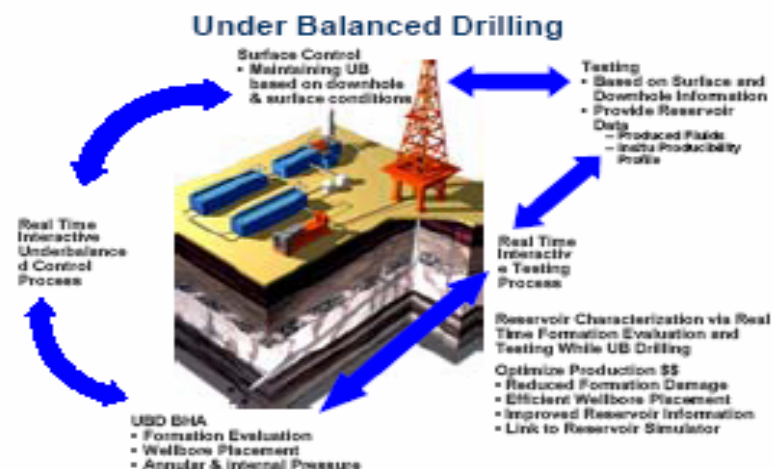
- WELL PRODUCTIVITY
  - Well productivity model
  - Water lift in fractured well
- HYDRAULIC FRACTURING
  - Standardise practices
  - Feasibility in horizontal wells
  - Fluid characterisation and modelling of damage at the face of the frac.
  - PEAs follow-up + US analogues + JIPs with Service C<sup>ies</sup>
  - Liquid blocking prevention



# TGR R&D Project: Technical Studies *cont'd*

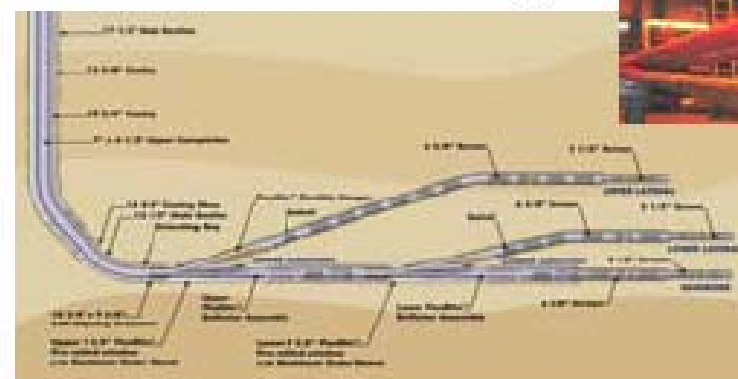
## PRODUCTION

- **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

## Multilateral technology





# TGR: Pilots

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- **IDENTIFICATION**
  - 3D Multi-azimuthal seismic
  - Multi azimuth 3D VSP
  - Frac monitoring using Micro-seismic
  
- **EVALUATION**
  - SonicScanner
  
- **PRODUCTION**
  - Water blocking
  - Hydraulic fracturing: proppants, injected fluids
  - Productivity Pilot
  - Under Balanced Drilling
  - Multi-lateral sub-horizontal drains



# TGR: Partnerships

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- **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

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## THANK YOU FOR YOUR ATTENTION

The authors would like to thank the R&D management of TOTAL for their authorization to present this paper

