Sour Gas Injection in Tengiz

Investor Relations Visit

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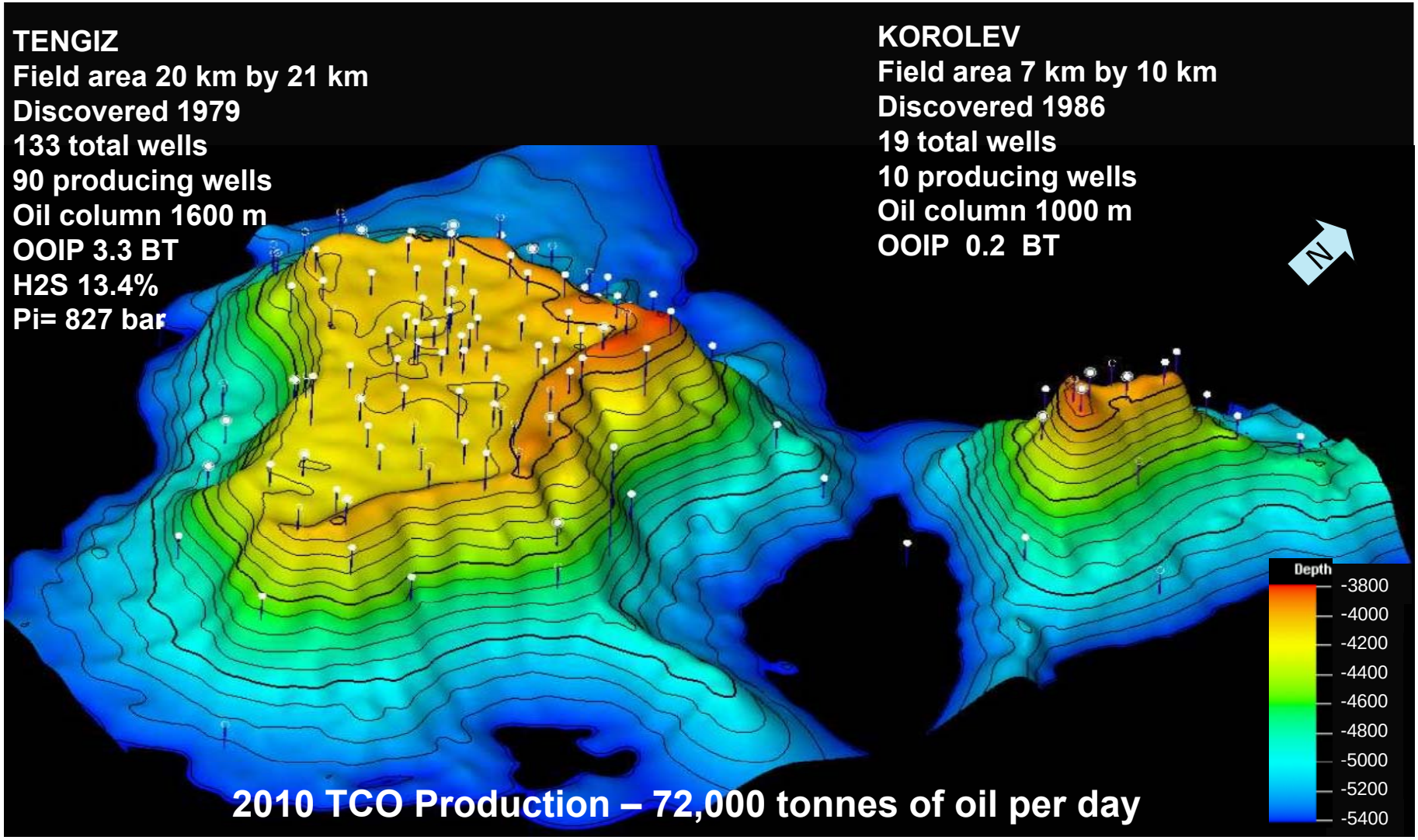
Atyrau, Kazakhstan

Tengiz and Korolev oil fields

Basic Reservoir Information

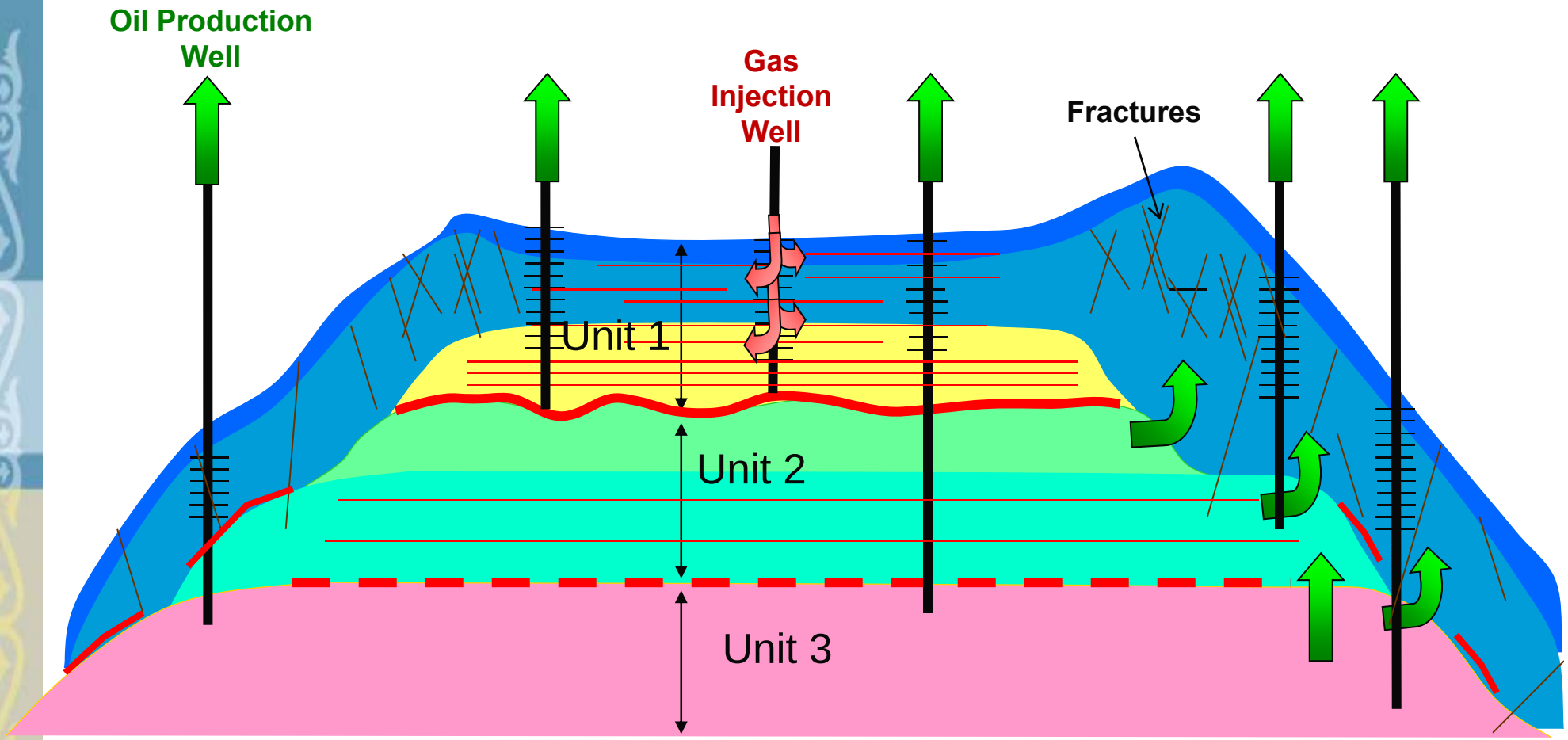
TENGIZ
Field area 20 km by 21 km
Discovered 1979
133 total wells
90 producing wells
Oil column 1600 m
OOIP 3.3 BT
H2S 13.4%
Pi= 827 bar

KOROLEV
Field area 7 km by 10 km
Discovered 1986
19 total wells
10 producing wells
Oil column 1000 m
OOIP 0.2 BT



2010 TCO Production – 72,000 tonnes of oil per day

Tengiz Reservoir
Reservoir Depletion Mechanisms



Three main depletion mechanisms

- Active Depletion of Unit 1 in Platform and Slope
- Passive Depletion of Units 2 and 3 via Unit 1 fractures
- Gas Injection in Unit 1 Platform

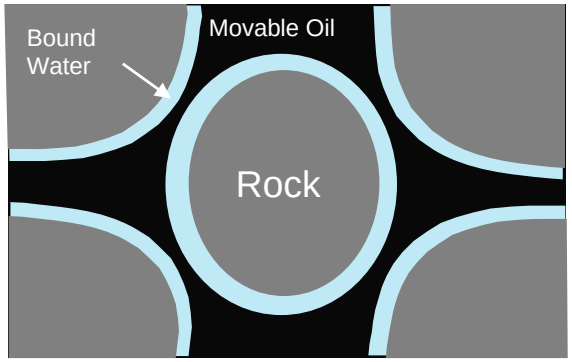
Gas Injection – Why does it Add Reserves?

Injected Gas Displaces Oil from Pore Spaces & "Cleans" the Reservoir

Without Injection

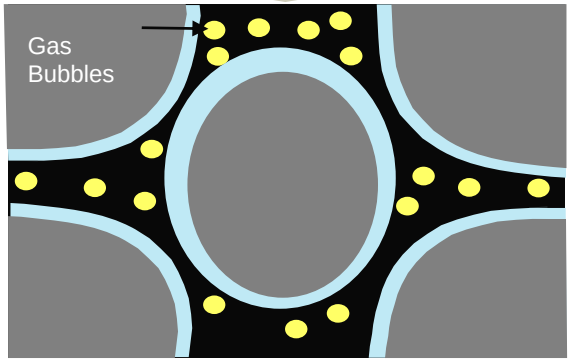
At High Pressure

Gas is dissolved in oil. Oil expands and flows into wells. Water is present but bound to the rock and cannot flow.



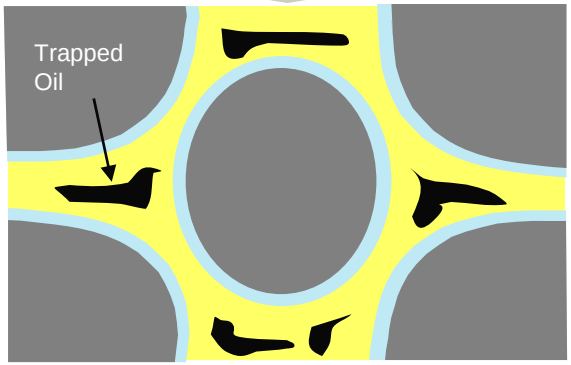
… As Pressure Drops …

Gas comes out of solution and forms bubbles in the oil. Movable oil and gas both expand and flow separately.



… until the Reservoir is Depleted

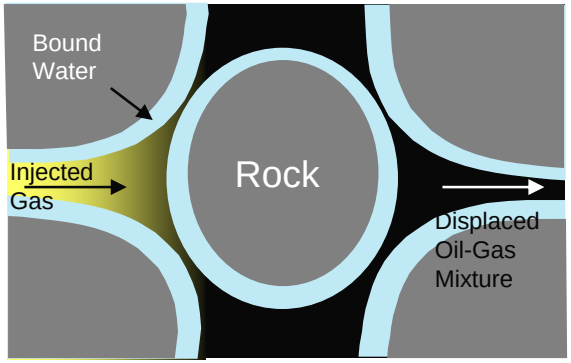
Most oil has turned to gas. Oil stops flowing but some residual oil is trapped in isolated pore spaces. Gas flows for as long as reservoir pressure allows.



With Injection

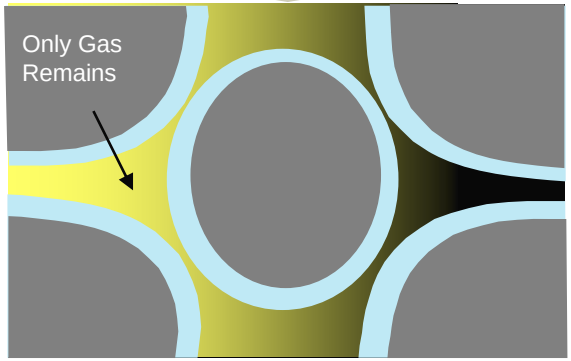
At High Pressure

Injected Gas mixes with *in-situ* oil. Oil and gas then flows through the rock as a mixture.



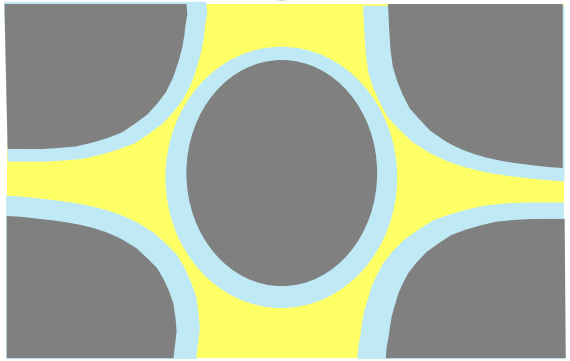
… As Pressure Drops …

After miscible gas flooding, only gas remains in pore spaces. This gas continues to expand and can be produced.



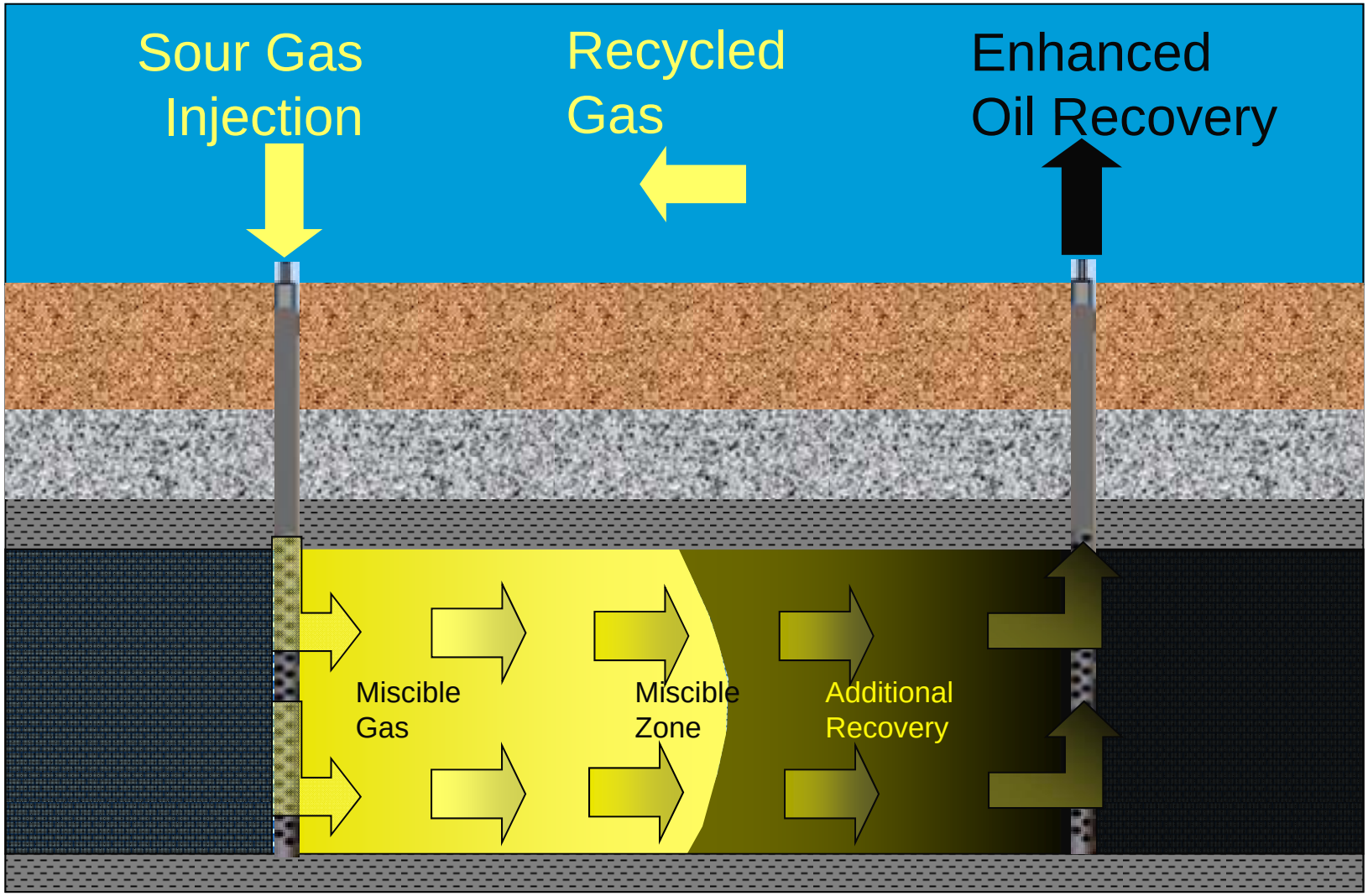
… until the Reservoir is Depleted

Gas flows for as long as reservoir pressure allows. There is little or no residual oil.



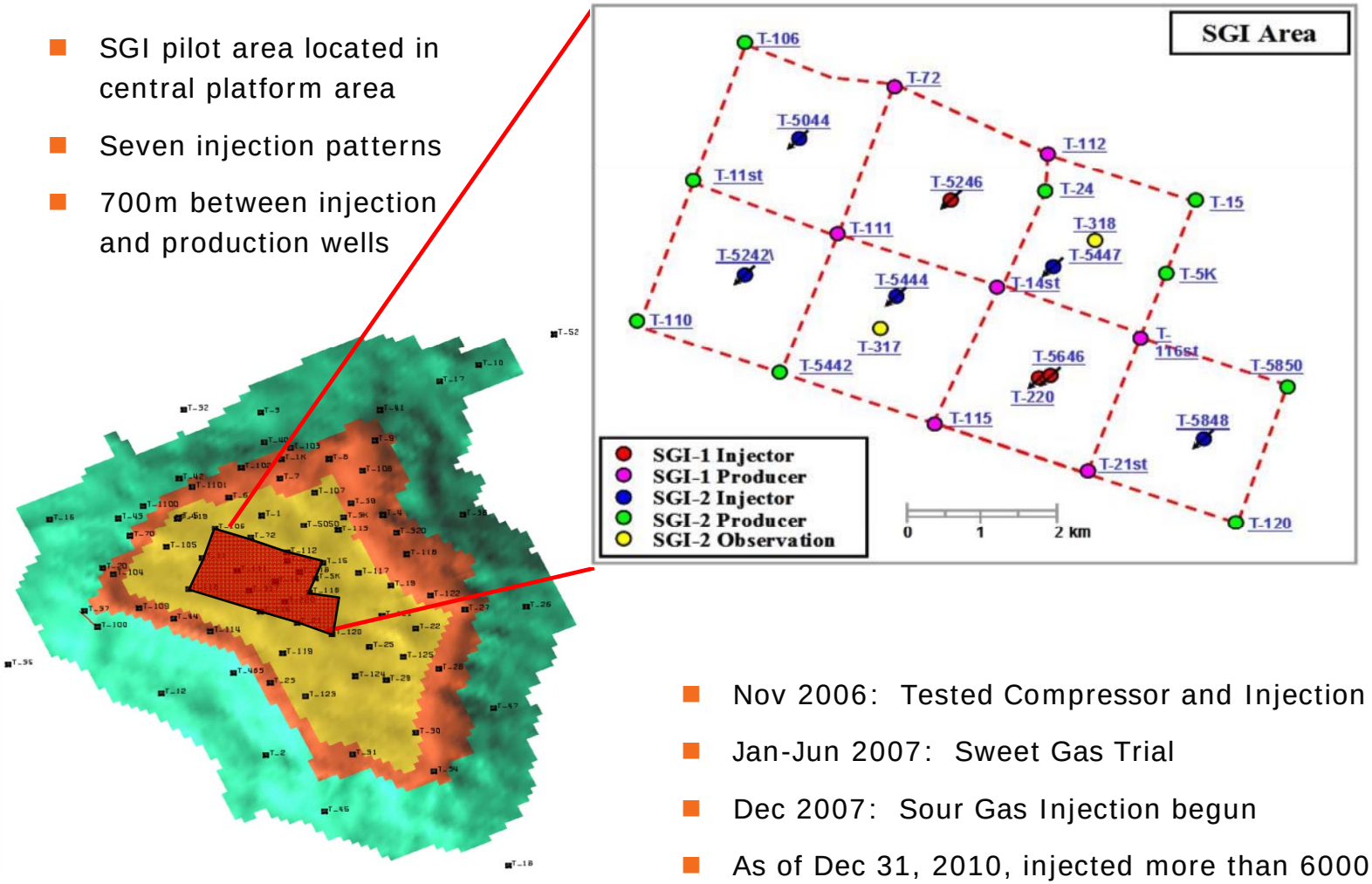
Re-injected Gas Sweeps the Reservoir "Clean"

And Slows Reservoir Pressure Decline



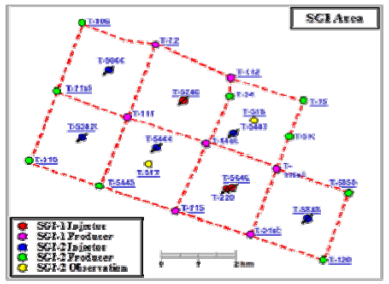
Tengiz Overview – SGI Pilot

- SGI pilot area located in central platform area
- Seven injection patterns
- 700m between injection and production wells



- Nov 2006: Tested Compressor and Injection
- Jan-Jun 2007: Sweet Gas Trial
- Dec 2007: Sour Gas Injection begun
- As of Dec 31, 2010, injected more than 6000 MMSm3

SGI Success Signposts



- Four key areas of SGI performance metrics

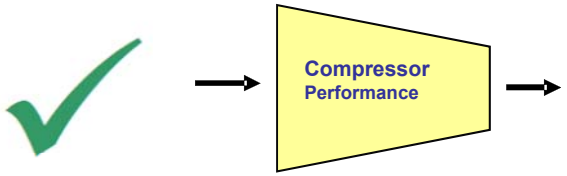
✓ 1. SGI Compressor Performance

✓ 2. Injection Well Injectivity

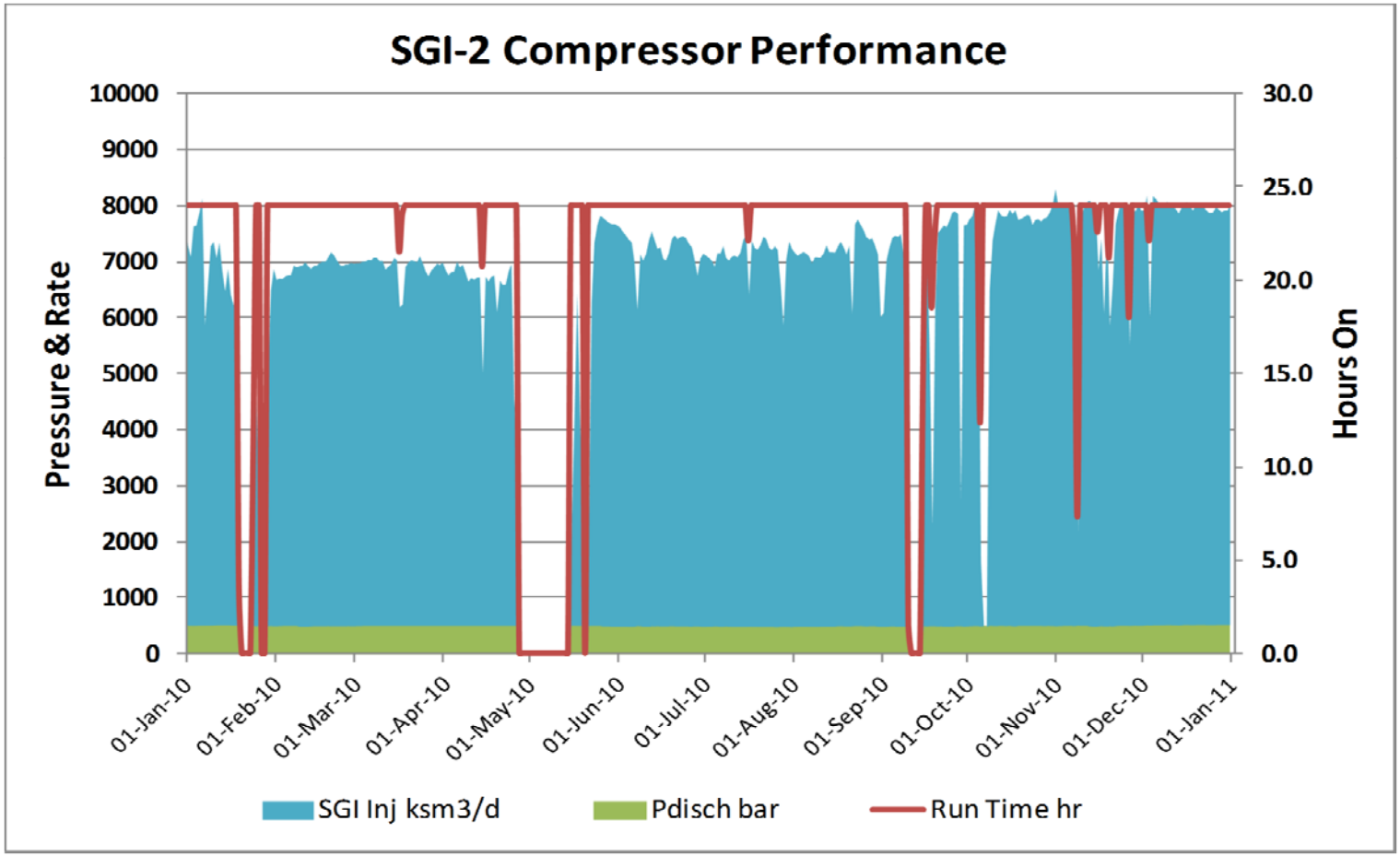
✓ 3. Injection Wellbore Durability

✓ 4. Reservoir Performance

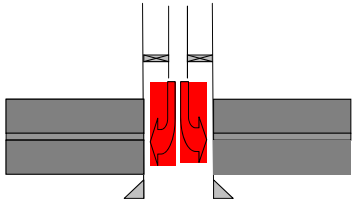
1. SGI Compressor Performance



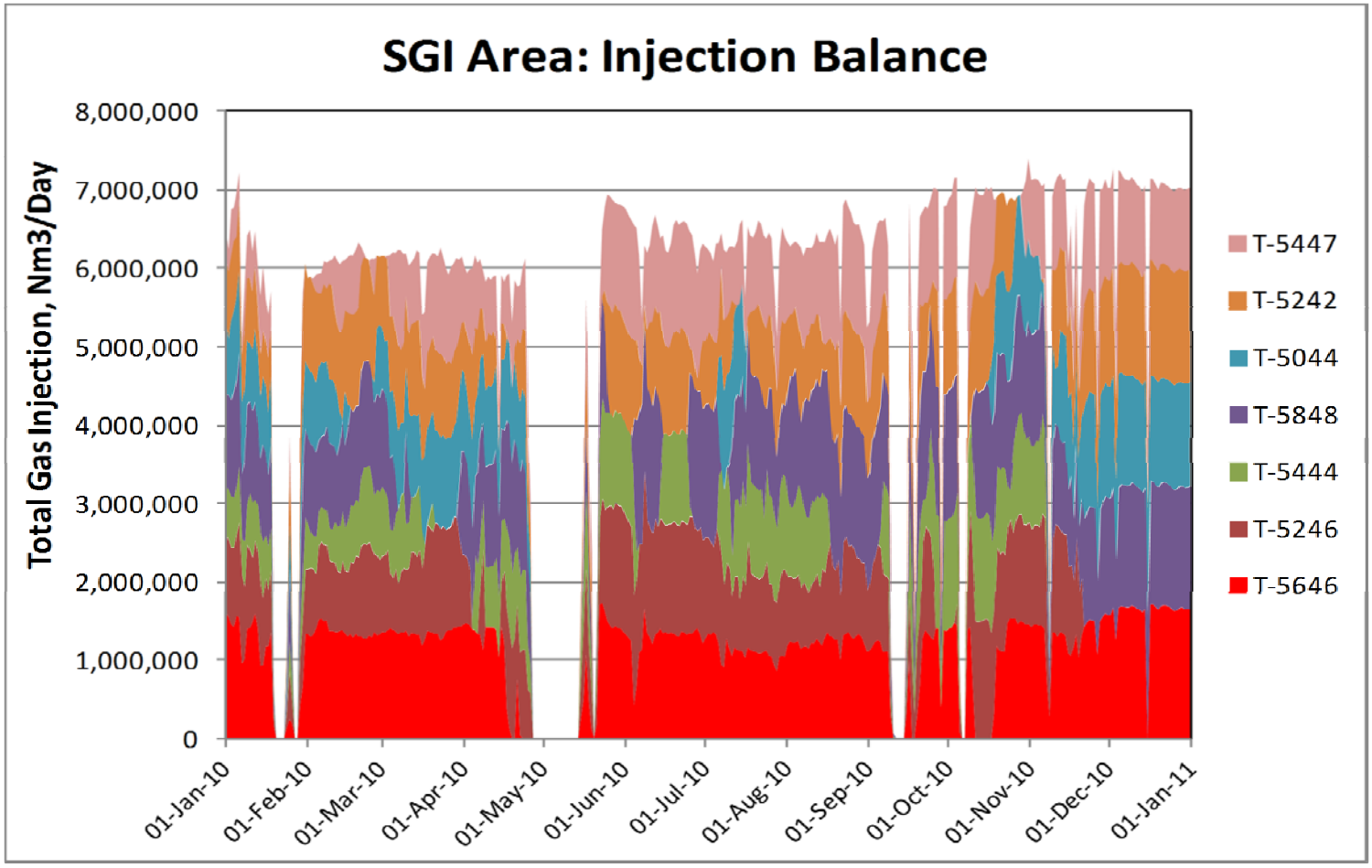
- SGI compressor was first of its kind
- Compressor operational greater than 90% of the time



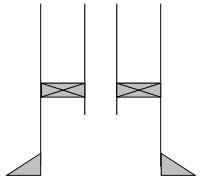
2. Injection Well Injectivity



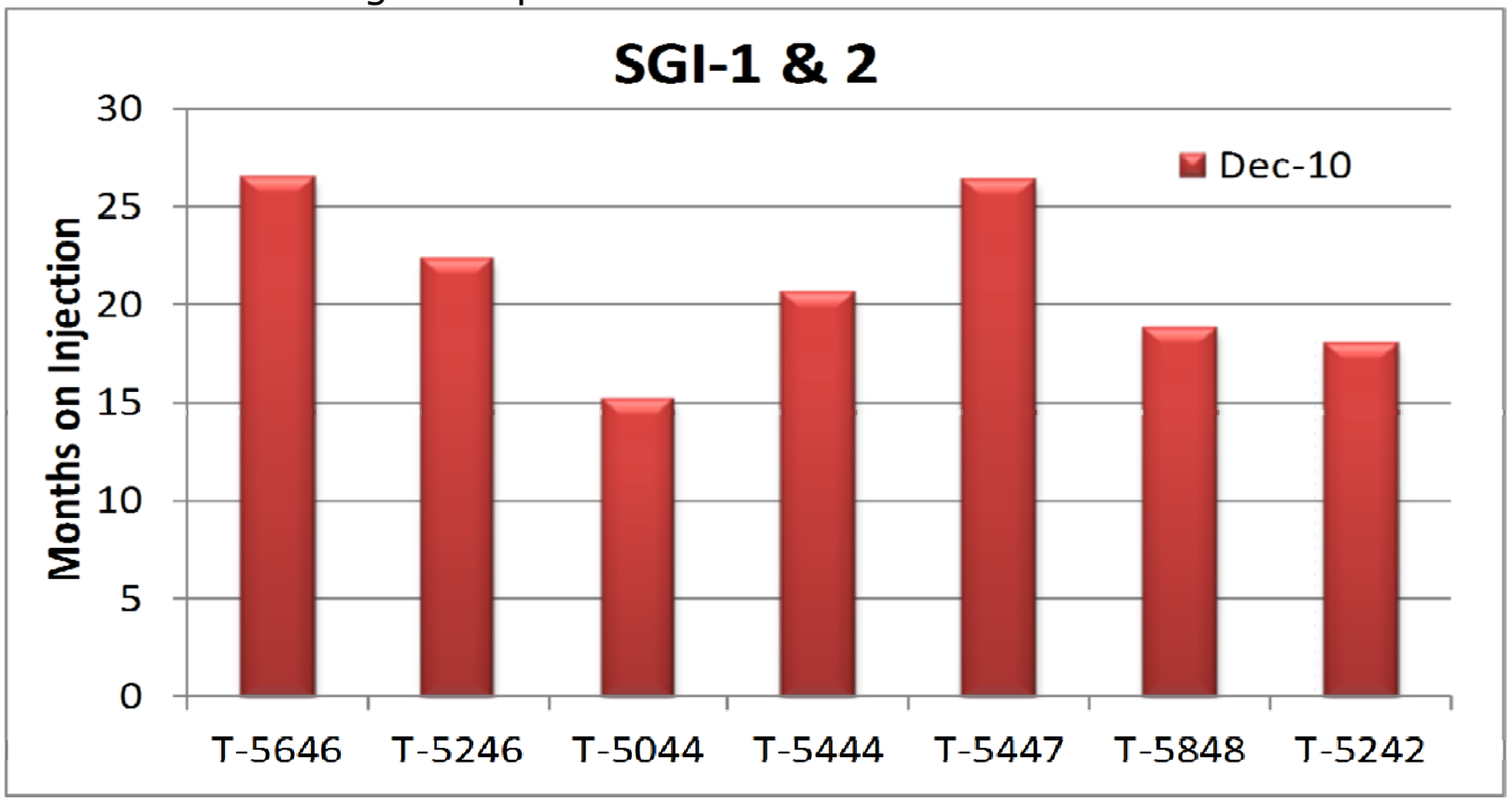
- Individual well injectivity is excellent and has exceeded expectations
- Gas injection has been maintained and is distributed evenly among all available gas injection wells



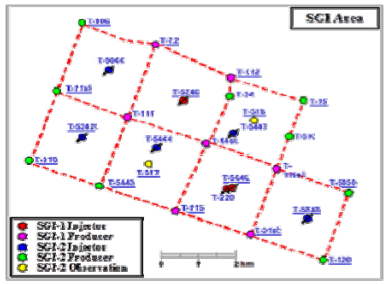
3. Injection Wellbore Durability



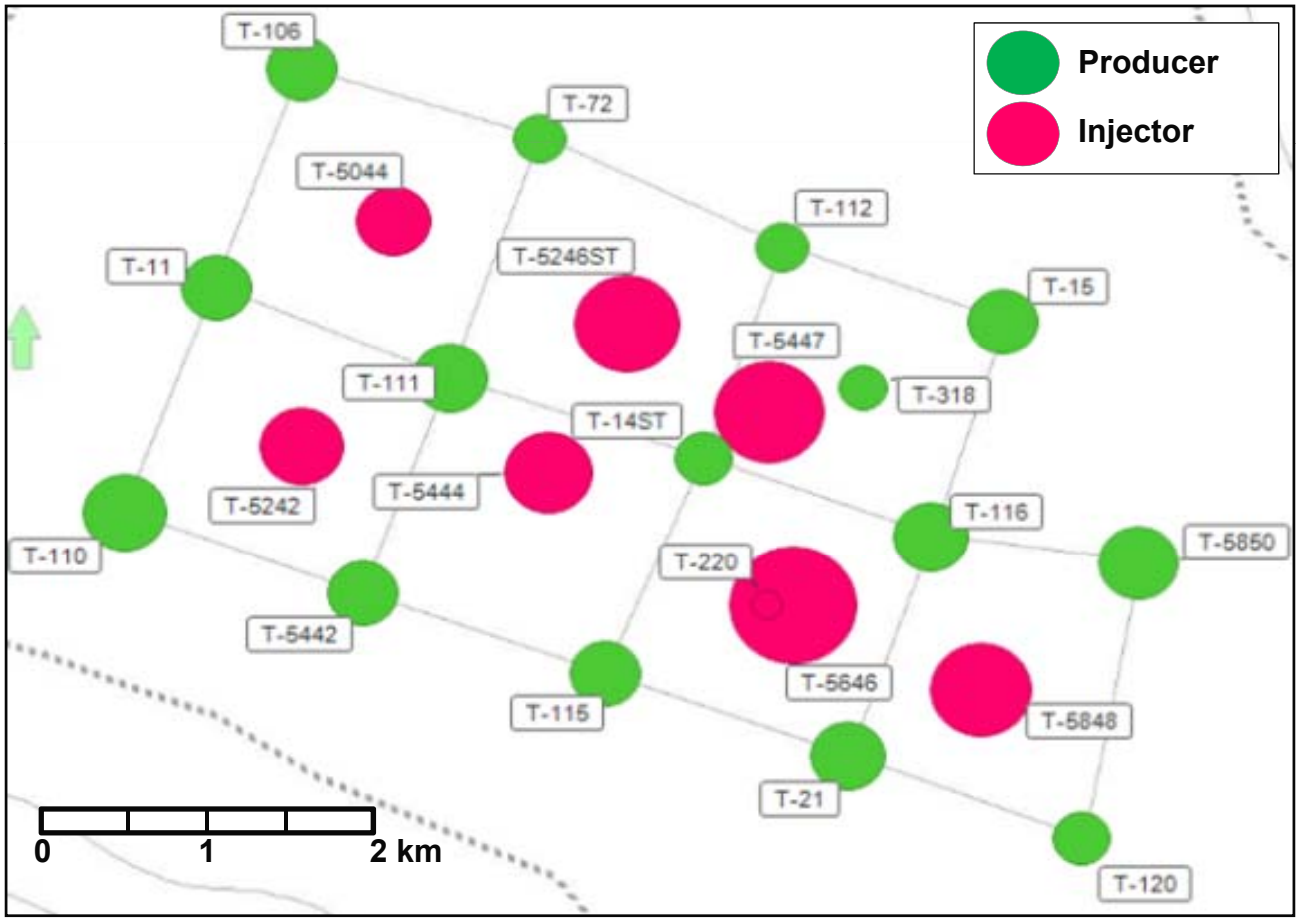
- All injection wells have had over 15 months of operational time, some have exceeded two years
- No well failures or wellbore remediation activity required on injection wells to during SGI operations



4. Reservoir Performance

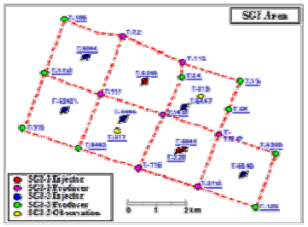


- In fourth year of injection
- Results consistent with expectations

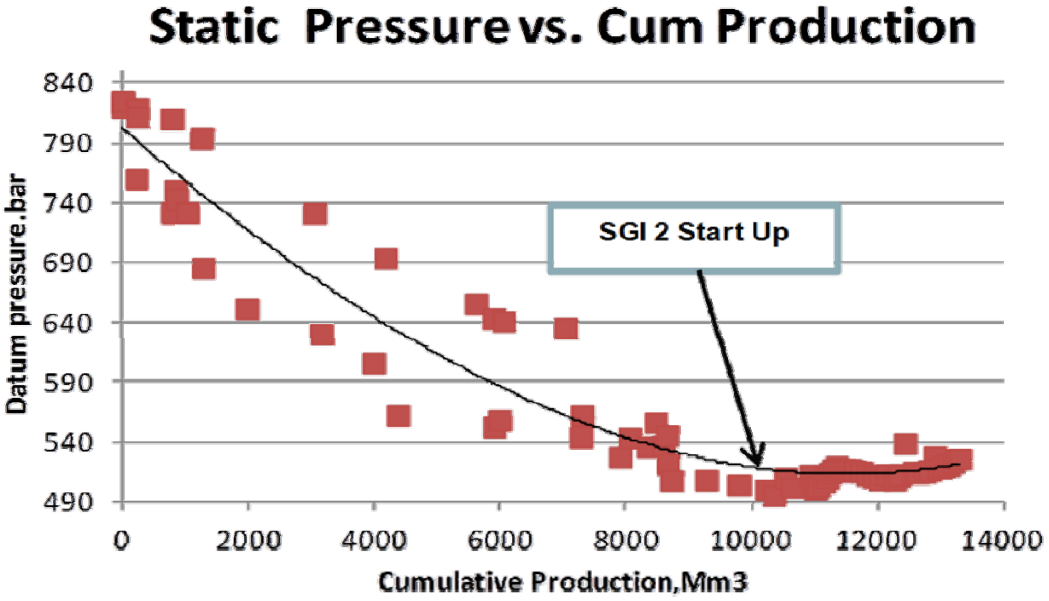


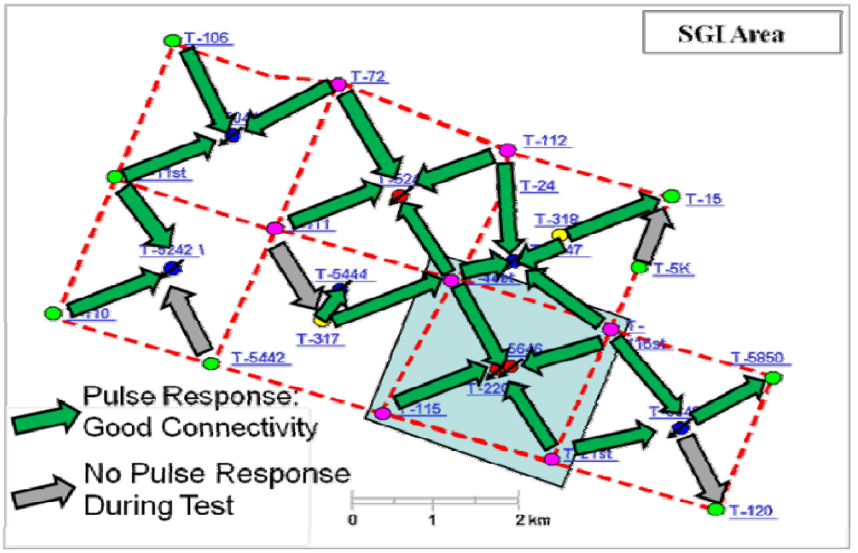
SGI Pilot Reservoir Performance

Reservoir Pressure response as expected



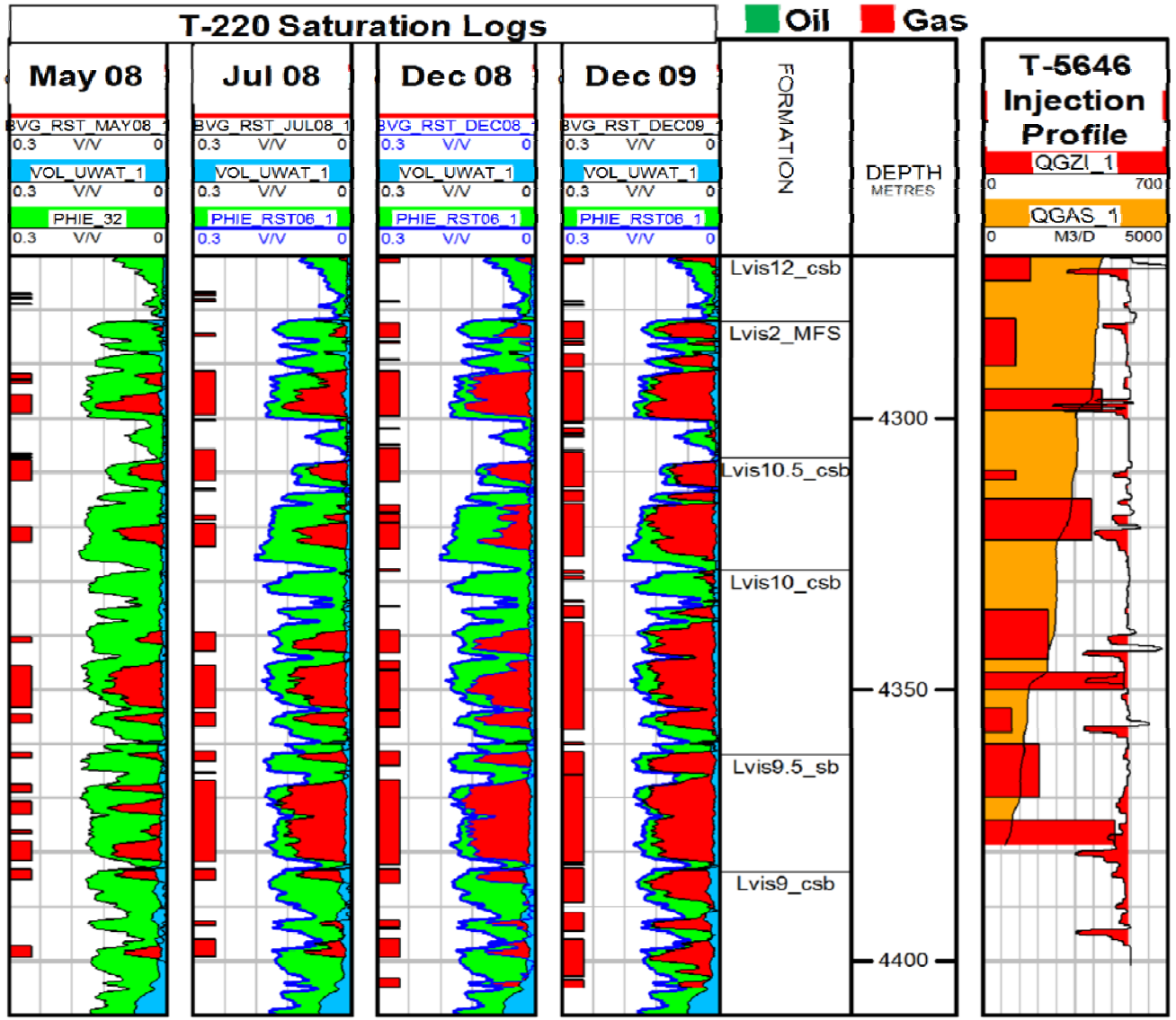
- All SGI patterns have shown changes in reservoir pressure decline consistent with expectations.
- Following the initiation of SGI, most injection patterns show a clear flattening and then increasing pressure trend.

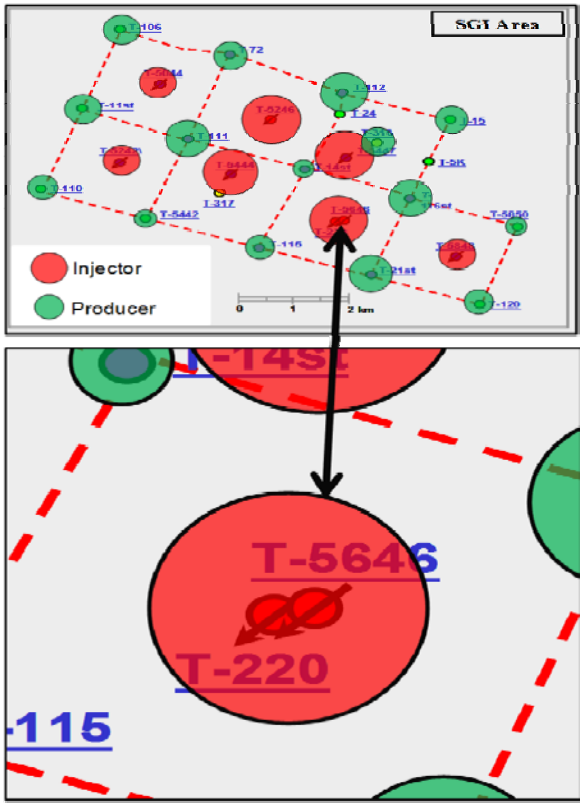




SGI Pilot Reservoir Performance

Saturation logs indicate high efficiency displacement

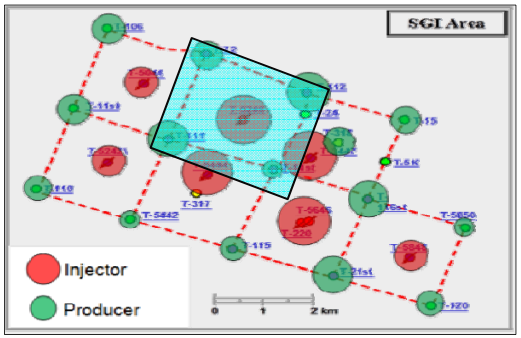




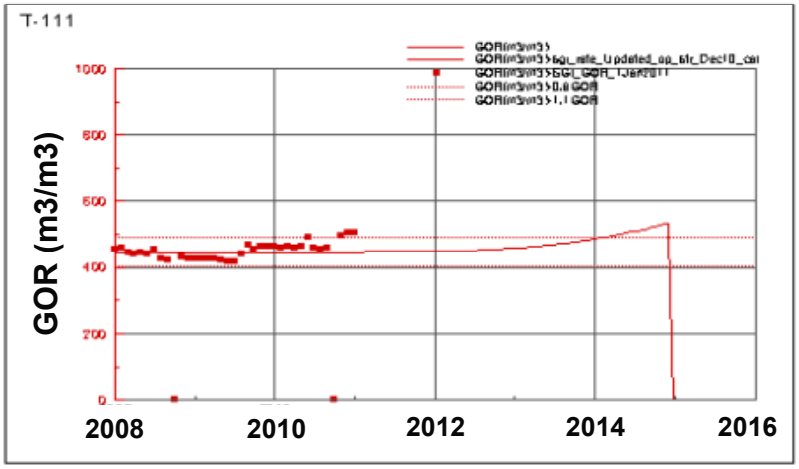
- 70% swept

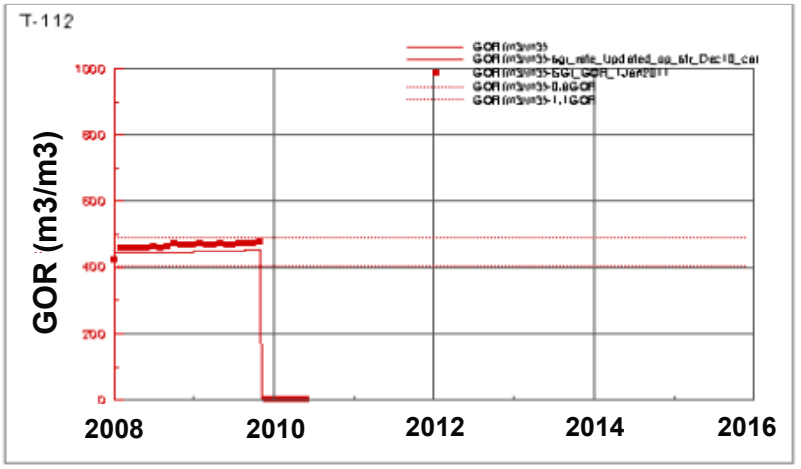
SGI Reservoir Performance

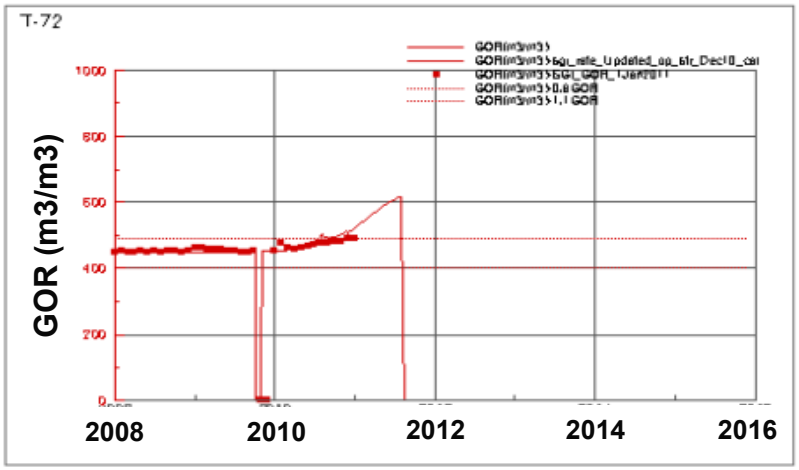
Field observations match model predictions

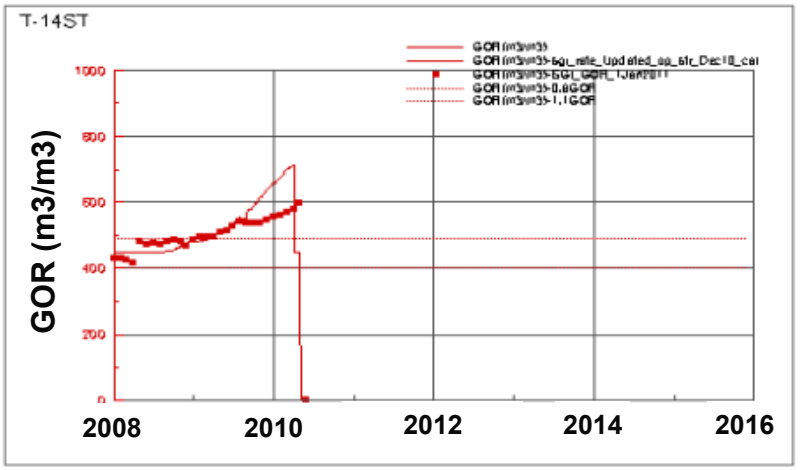


GOR(m3/m3)









Sour Gas Injection Pilot Project
Summary

- The SGI pilot at Tengiz has been very successful.
  - Sour gas can reliably be injected into the Tengiz reservoir
  - Reservoir response to SGI is positive and predictable
- Implementation of an SGI Expansion at Tengiz can be expected to improve production rates and increase reserves substantially.