A Proposal for Simultaneous Production of Shale Gas and CO2 storage Using a Gas-Assisted Approach

A conventional approach for unconventional reservoirs

Group 2

Outline

1. Problem statement
2. Objective
3. Assumptions
4. Methodology
5. Instrumentation and Monitoring
6. Pros & cons

Problem statement

Challenges we are faced with unconventional reservoirs:

1. Low or ultra-low permeability of shale plays
2. High water sensitivity
3. Low effective porosity for CO2 storage
4. Frac-driven interactions using water-based fracturing fluid

European Scientist

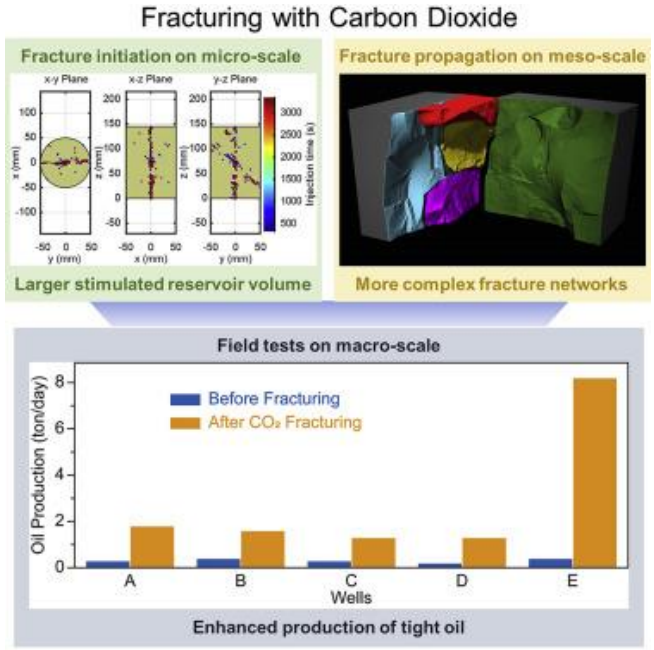
Energy | Environment | Agriculture | Big Data | Public Health | Research | Features | Search...

Home » Energy » Greener fracking? Swapping water for CO2 could be more effective

- Energy -

Greener fracking? Swapping water for CO_2 could be more effective

By Siobhán Dunphy - 01.06.2019



Joule

CellPress

Volume 3, Issue 8, 21 August 2019, Pages 1913-1926

Article

Fracturing with Carbon Dioxide: From Microscopic Mechanism to Reservoir Application

Xuehang Song [1, 5], Yintong Guo [2, 5], Jin Zhang [3, 5], Nannan Sun [1, 6] ✉, Guofei Shen [1], Xin Chang [2], Weisheng Yu [1], Zhiyong Tang [1], Wei Chen [1], Wei Wei [1] ✉, Lei Wang [2], Jun Zhou [2], Xiao Li [4], Xiaofeng Li [3], Jinhui Zhou [3], Zhenqian Xue [3]

Show more

https://doi.org/10.1016/j.joule.2019.05.004

Highlights

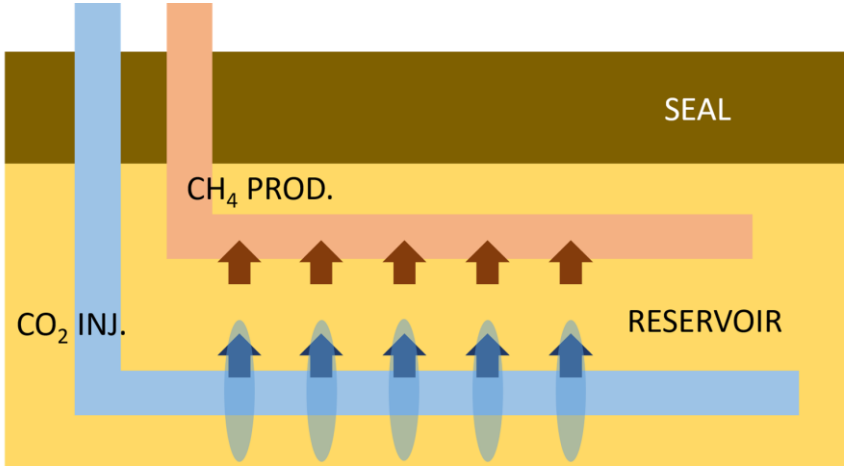
- CO_2 fracturing is more effective in reservoir stimulation than water
- Multiscale mechanism of CO_2 fracturing was experimentally established
- 4- to 20-fold increase in tight oil production was achieved by CO_2 fracturing

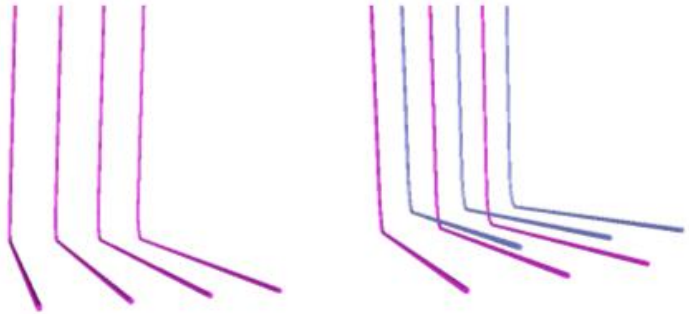
Assumptions

- Shale above the unconventional reservoir acts as an Impermeable seal
- CO2 source is readily available reducing the cost of transportation
- Unconventional reservoir has better affinity for CO2 over hydrocarbon (3 to 7 times)

Methodology

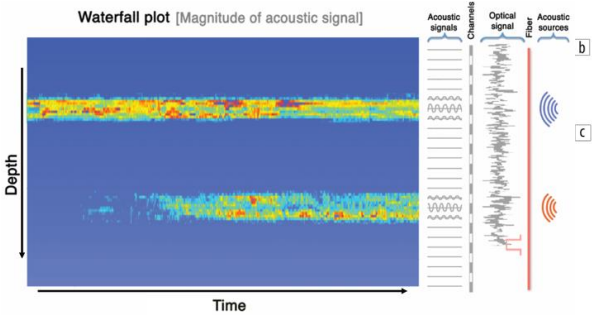
- Horizontal wells
- Multi-stage cryogenic fracturing using supercritical CO2
- Gas Assisted Gravity Drainage
- CH4 and CO2 de/adsorption

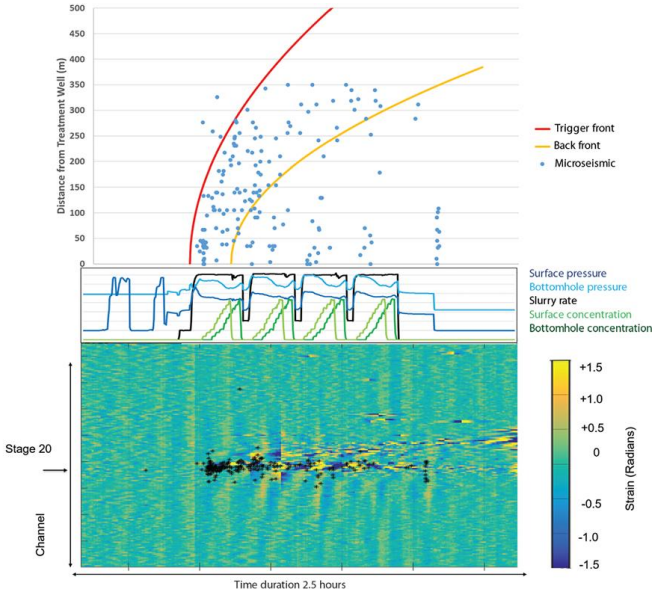




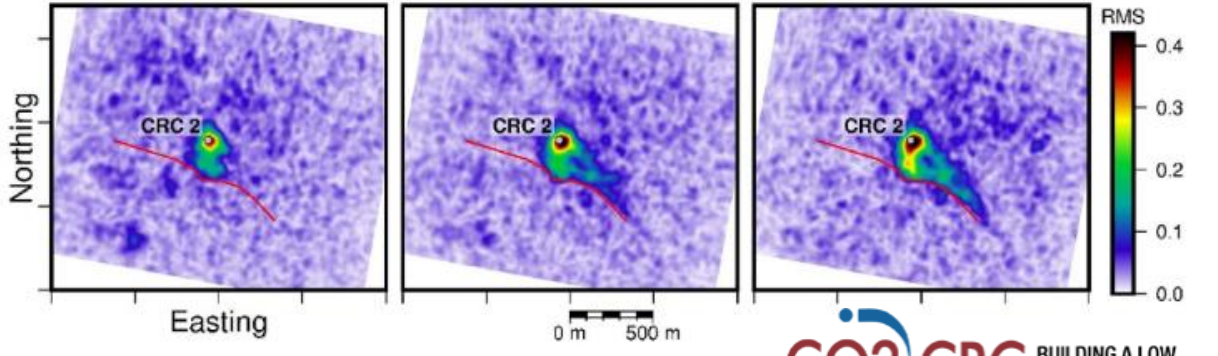
Instrumentation and Monitoring

- Downhole Pressure and Temperature Gauges
- Fiber Optic Cables
  - Distributed Acoustic Sensing
    - Injection
    - Microseismic
    - Cross-well Strain
    - SRV volume
- Surface Orbital Vibrators
  - On-demand CO2 monitoring





Karrenbach et al., 2017



Pevzner et al., 2017

CO2CRC BUILDING A LOW EMISSIONS FUTURE

CO2 Storage Mechanisms:

- Structurally confine injected CO2 within unconventional reservoirs
- Displacement of CH4 through flooding

CO2 Adsorption within Shale

CO_2 can be adsorbed by the kerogen[1] or clays within shale.[2, 3]

CO_2 adsorbs to shale approximately >4 times more strongly than CH_4.[5]

CO_2 adsorption is decreased when water is present, as water can block access of CO_2 to shale.[6]

(1) Zhu et al. *Energy & Fuels* **2018,** *32* (2), 1374-1386. (2) Al Ismail et al. Society of Petroleum Engineers: Dammam, Saudi Arabia, 2017; p 12. (3) Kim et al.. *SPE/IATMI Asia Pacific Oil & Gas Conference and Exhibition*,, Indonesia, 2015; p 17. () Tang et al. *SPE Argentina Exploration and Production of Unconventional Resources Symposium*, Buenos Aires, Argentina, 2016; p 9. (6) Sanguinito et al. *Fuel* **2018,** *226*, 54-64.

Advantages and Challenges

Advantages

- Process utilizes CO_2 in fracture formation as well as foam fracturing
- Safe and secure permanent CO_2 sequestration
- CO_2 fracturing is advantageous because water fracturing decreases the amount of CO_2 which can be adsorbed in shale nanopores

Challenges

- Reservoir Characterization for application of the proposed methodology
- Effective vertical and areal displacement efficiency

Thank you

Any questions?

Economic Analysis -

- Well Costs ~ 5.5 $MM (2 wells required)
- CO2 purchase for continuous injection- $ 25/ Mt

- Well Life - 25 yrs.