Hydraulic Fracturing: Points and Counter Points

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ISC
Isc.usc.edu

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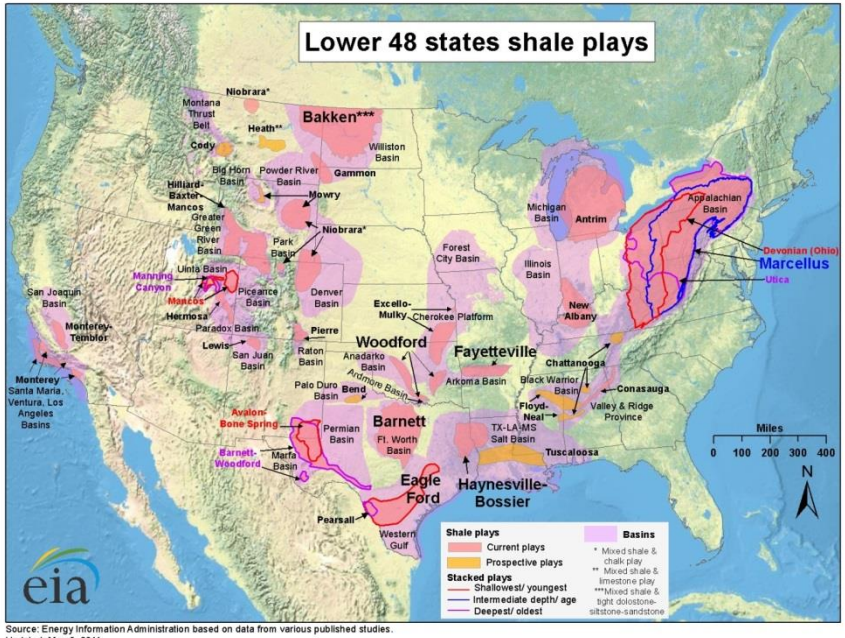
Summary

- What is Hydraulic Fracturing (Fracking)
- Fracking Risk Factors
- Induced Seismicity
- Monterey shale
- Balance

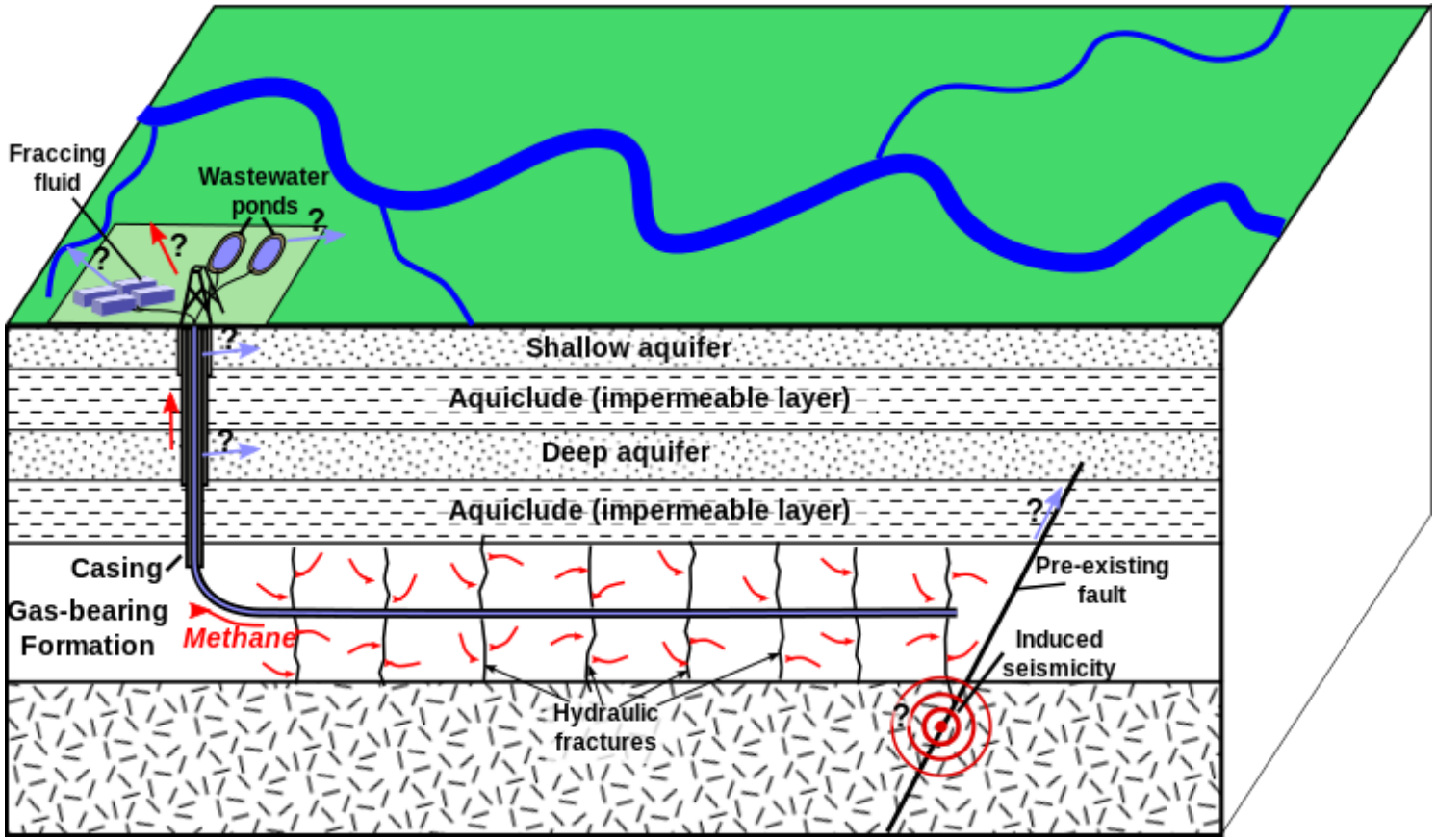
Fracking: Overview

- **Natural gas**: good alternative for fossil fuels (less CO2 production)
- **Shale Formation,** low permeability, rich of natural gas (known as **Shale Gas**)
- Unconventional vs. Conventional
- **The Potential Gas Committee:** within **five years** the potential reserves of shale gas has tripled from **200 trillion cubic feet** in 2006 to nearly **700 trillion cubic feet** in 2010
- Tight formation => Stimulation Methods to change the permeability (**Hydraulic Fracturing**)



Shale plays in the USA (EIA)

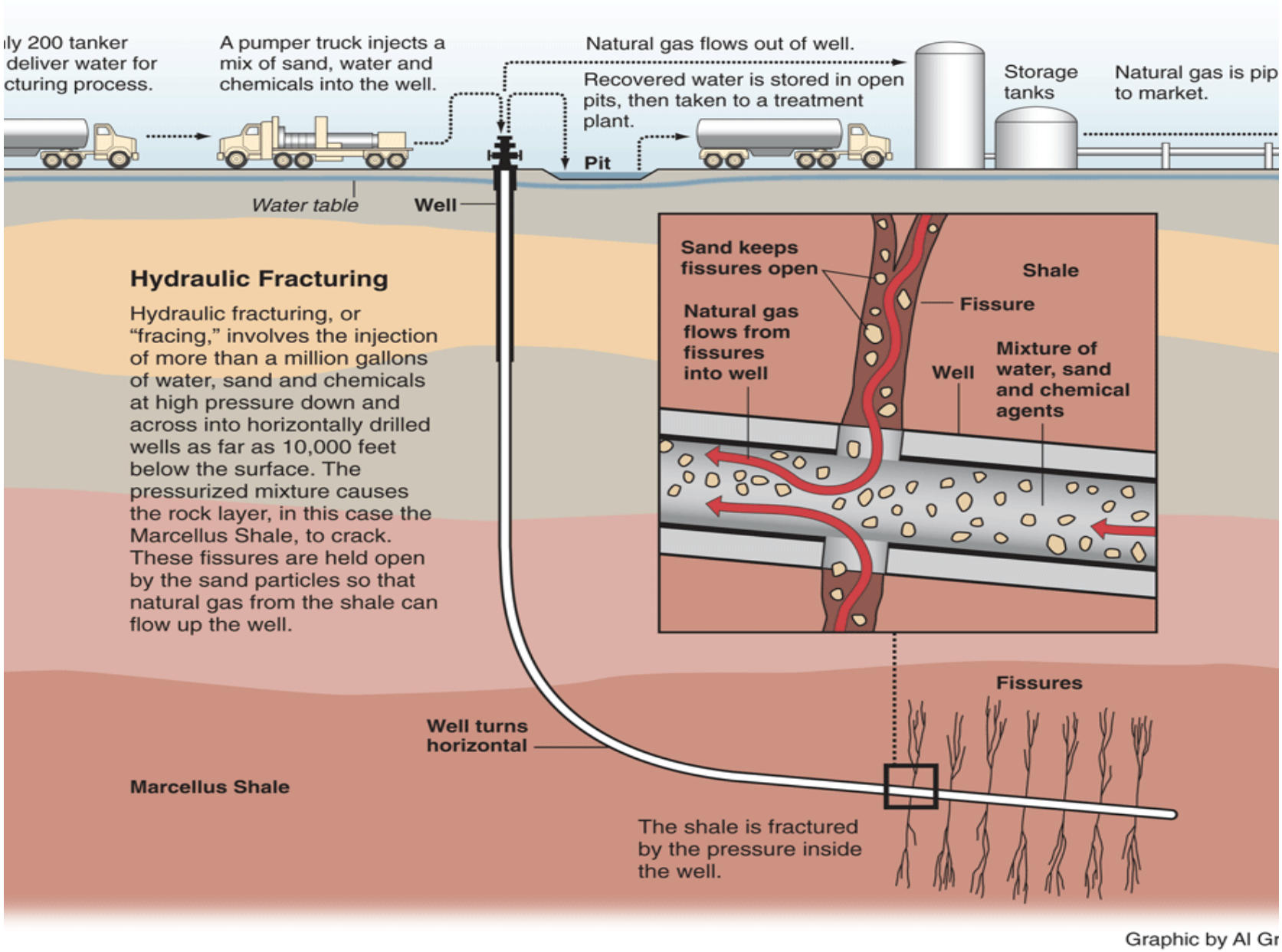
What is Fracking



- **Hydraulic fracturing** is stimulating rock layers by a pressurized liquid to facilitate release **of** gas and oil.
- It creates fractures from a wellbore drilled into reservoir

http://en.wikipedia.org/wiki/Hydraulic_fracturing

More on Fracking



Why worry?

- ✓ HF fluid = water and various chemical additives.
  - ❑ 750 chemicals (toxic) in the HF fluids
  - ❑ The choice of the chemicals and quantities vary according to site conditions & project needs
  - ❑ Commonly used chemicals:
    - ➢ HF fluid: methanol, isopropanol, quartz, ethylene glycol monobutyl ether, ethylene glycol, light petroleum distillates and sodium hydroxide
- ✓ Recovered HF fluids → contaminated when in contact with the shale.
- ✓ Accidental spill of the HF fluid (**prior to injection** or **recovered**)

More on Potential Risk Factors

- Contamination of ground water
- Depletion of fresh water **(Recovered fluid: 25-100 %)**
- Risks to air quality **(CH4, VOC's)**
- Migration of gases and chemicals to the surface
- Surface contamination from spills and flow-back
- Induced Seismicity

Examples of Risk Pathways: Groundwater Contamination

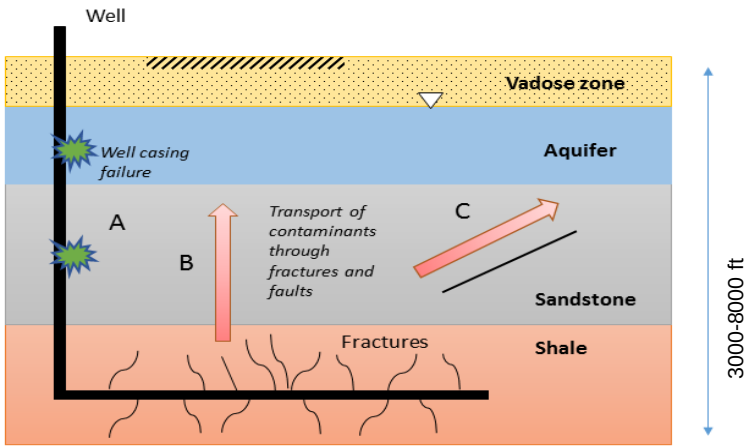


Figure 3. Schematic illustration of the conceptualization associated with S2, showing multiple contaminant pathways stemming from the subsurface. The HF fluid and other contaminants can travel toward groundwater aquifer through failed well casing (A), fractures (B), and faults (C).

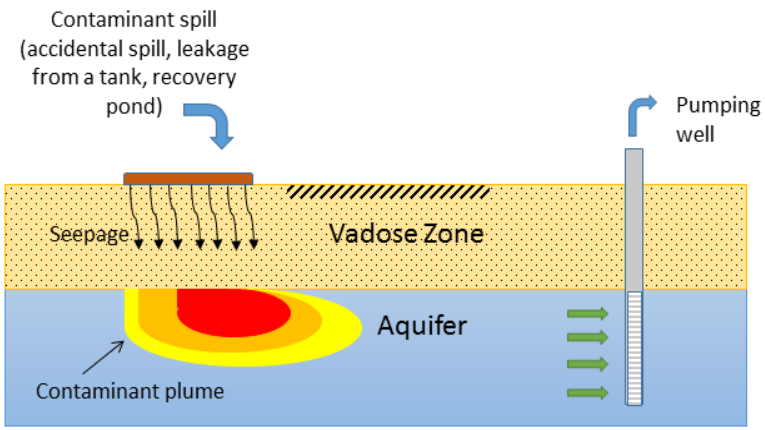


Figure 2. Conceptual illustration for surface to aquifer contamination pathway (items 1 and 3).

Rupture in the well! Contamination of the aquifer.

Spill in the ground surface! Contamination of the vadose zone and eventually the aquifer.

Contamination from Recovered HF Fluid

- Recovered HF fluids may become contaminated once they are in contact with the shale.
- HF fluids extract heavy metals, hydrocarbons, natural salts and radioactive materials from the shale.
- Recovered HF fluids may contain the following chemicals: **chloride**, **sodium**, **bromide**, **arsenic**, **barium** and natural occurring radioactive materials (**NORM**) such as uranium, radon and radium [Rozell and Reaven, 2012] as well as high **TDS** values (**70,000 to 250,000 mg/L**) [NETL, 2013]

Any accidental spill related to the HF fluid (prior to injection or recovered) can pose risk to aquifers and human health (many of these chemicals are carcinogenic)

Introduction to Induced Seismicity

fracture treatment / Fluid Injection / CCS

↓

Increase in stress and pore Pressure

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Decrease the stability of existing weak planes (natural fractures, bedding planes)

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slip and fail, similar to earthquakes along faults

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slippages emit elastic waves (stimulated seismicity)

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Induced Seismicity Data Base

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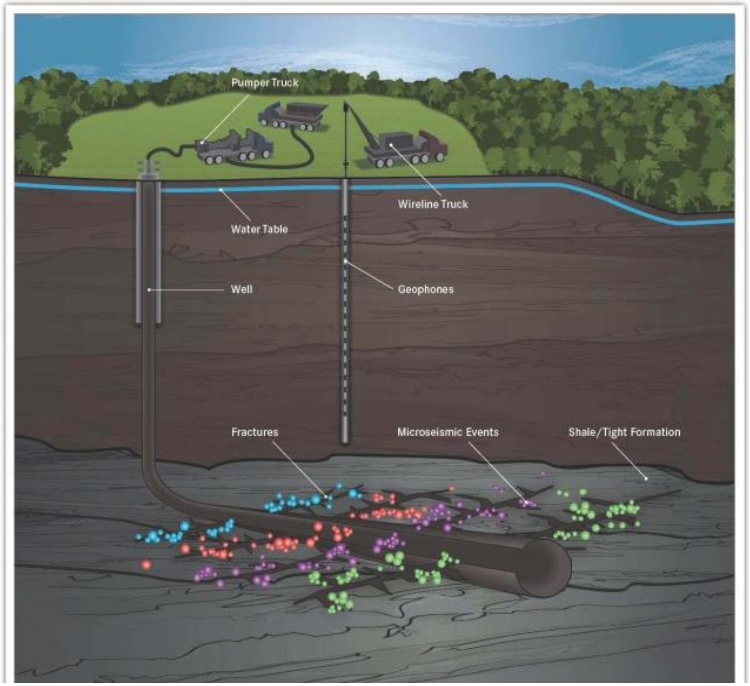
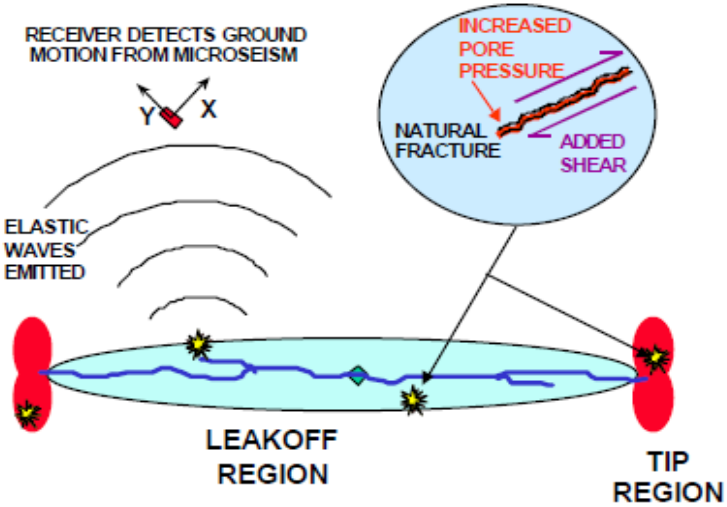
Models-IS Risk Maps





Preliminary Observations on Induced Seismicity

- The energy level which is released is **large enough to be recorded**, but too low to **directly** create major seismic events,
- **Real time monitoring** of Micro-earthquake data can help mitigate or reduce the risk of triggering large damaging earthquakes,
- We are looking into three test beds**: San Joaquin Valley, CA, Youngstown, Ohio and Blackpool, UK,**
- Similar to the "Earthquake Hazard Maps", **IS hazard maps** can alleviate the concerns for IS risk of SFIP in the majority of cases,
- **More modeling**, statistical analysis and research needed to substantiate some of the preliminary conclusions.

California Monterey Shale

- (EIA) estimates the Monterey/Santos play holds 15.4 bbo of shale resources; the Bakken and Eagle Ford combined have about 7 bbo
- The Monterey shale is the primary source rock for the conventional oil reservoirs found in the Santa Maria and San Joaquin basins in southern California.

California play full of complexities Monterey Shale Continues to Tempt and Tease

www.aapg.org/explorer/2013/02feb/monterey_shale0213.cfm

http://www.aapg.org/explorer/2012/11nov/monterey1112.cfm

Monterey Shale Development, Pros and Cons

Benefits:

- Create more jobs: 512K to 2.8 million new jobs
- Stimulate economy. GDP up by 2.6-14.3%
- Increase personal income. Up by 2.1-10.0%
- Boost State revenue. Tax growth $4.5-24.6B

GEN

Global Energy Network

University of Southern California

Caveats:

- Exploratory study and preliminary results
- Warrants further multi-dimensional studies
- Need to examine: environmental issues,
- Need to address technology challenges

The Monterey Shale & California's Economic Future

March 2013

http://gen.usc.edu/assets/001/84954.pdf

Should Fracking Stop?

A drilling operation in Bradford County, PA:

Extracting gas from shale increases the availability of this resource, but the health and environmental risks may be too high.

POINT

Yes, it's too high risk

Natural gas extracted from shale comes at too great a cost to the environment,

Say Robert W. Howarth and Anthony Ingraffea.

COUNTERPOINT

No, it's too valuable

Fracking is crucial to global economic stability; the economic benefits outweigh the environmental risks,

says Terry Engelder.

http://www.nature.com/nature/journal/v477/n7364/full/477271a.html

Balance

Concerns to Address

- Water supply contamination
- Increased induced seismicity
- Land-use challenges
- Water-use challenge
- Potential to overwhelm community infrastructure
- Continued reliance on fossil oil

Possible Steps

- More Science
- More Disclosure
- Understand economic impacts of extreme measures
- Improve Education/Outreach
- Listen to both sides

To Frack or not to Frack, That is the Question

Science is the Answer: Vincit Veritas (Truth Prevails)

Summary

- What is Hydraulic Fracturing (Fracking)
- Fracking Risk Factors
- Induced Seismicity
- Shale Resources and the Role of Fracking in their Development
- Monterrey shale and its potential economic impacts in California
- Technology requirements for Monterrey shale development
- Where do we go from here

Thanks!