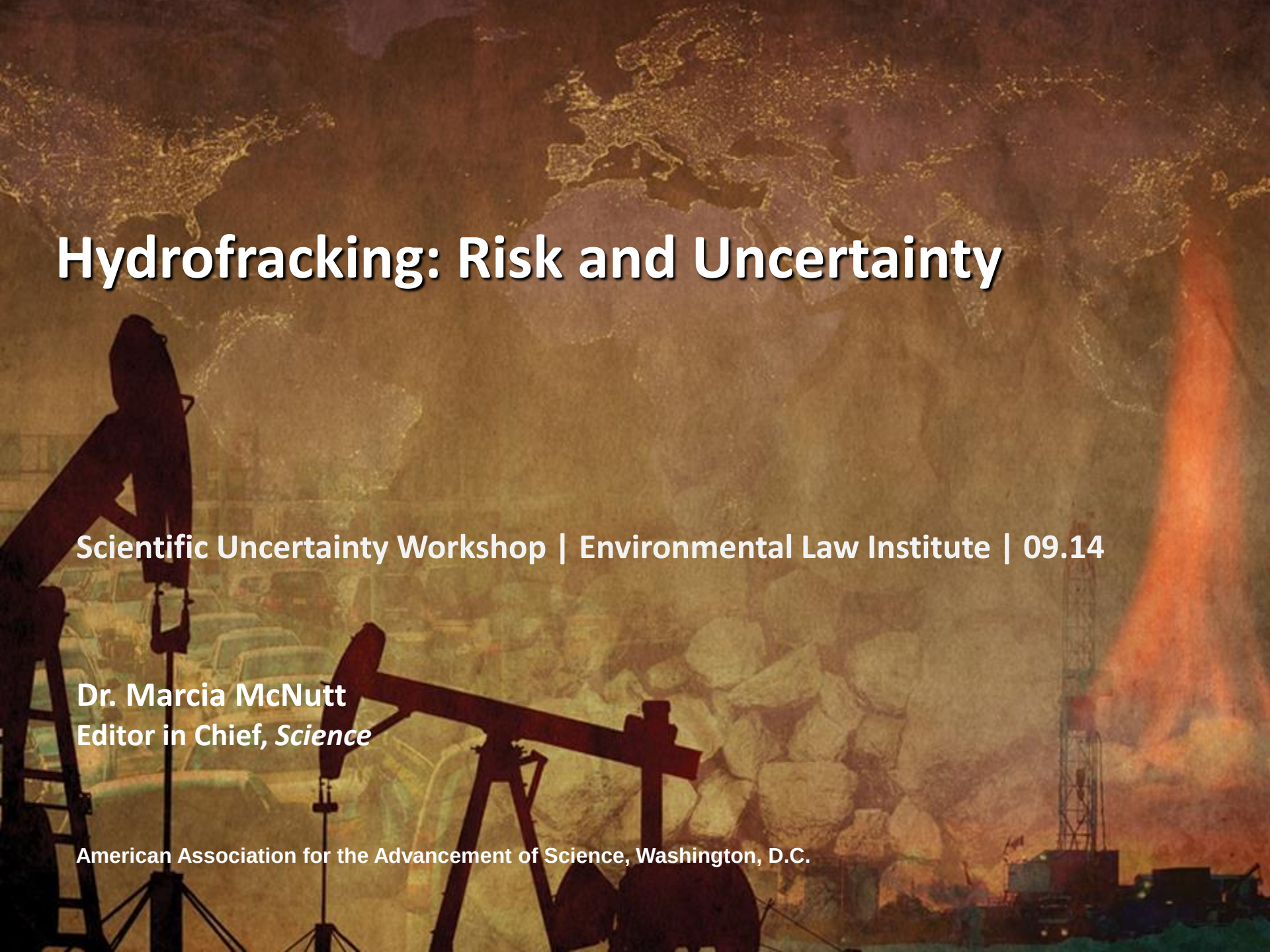


Hydrofracking: Risk and Uncertainty

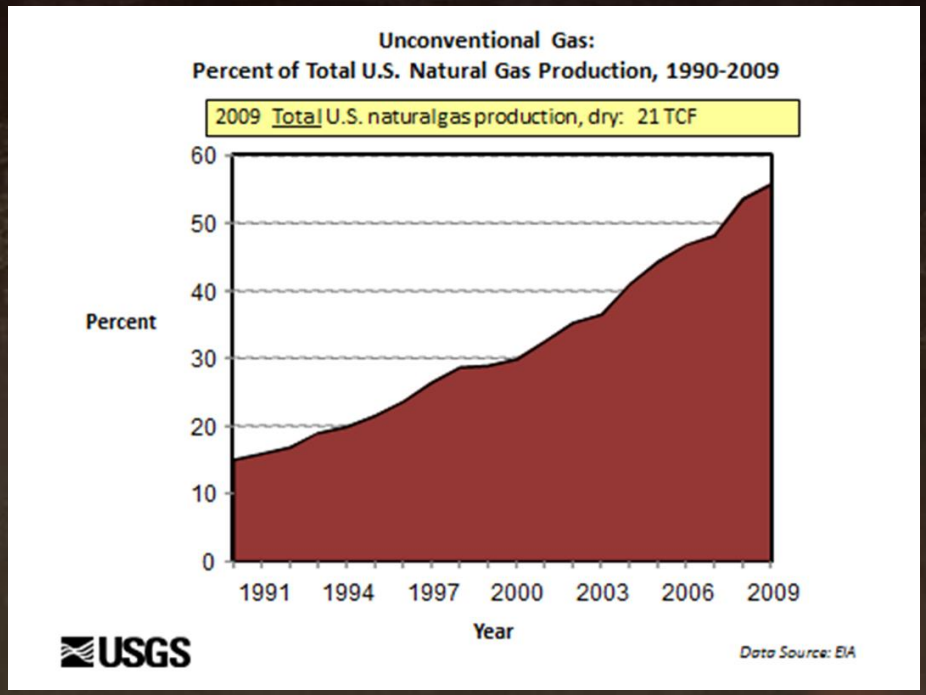
Scientific Uncertainty Workshop | Environmental Law Institute | 09.14

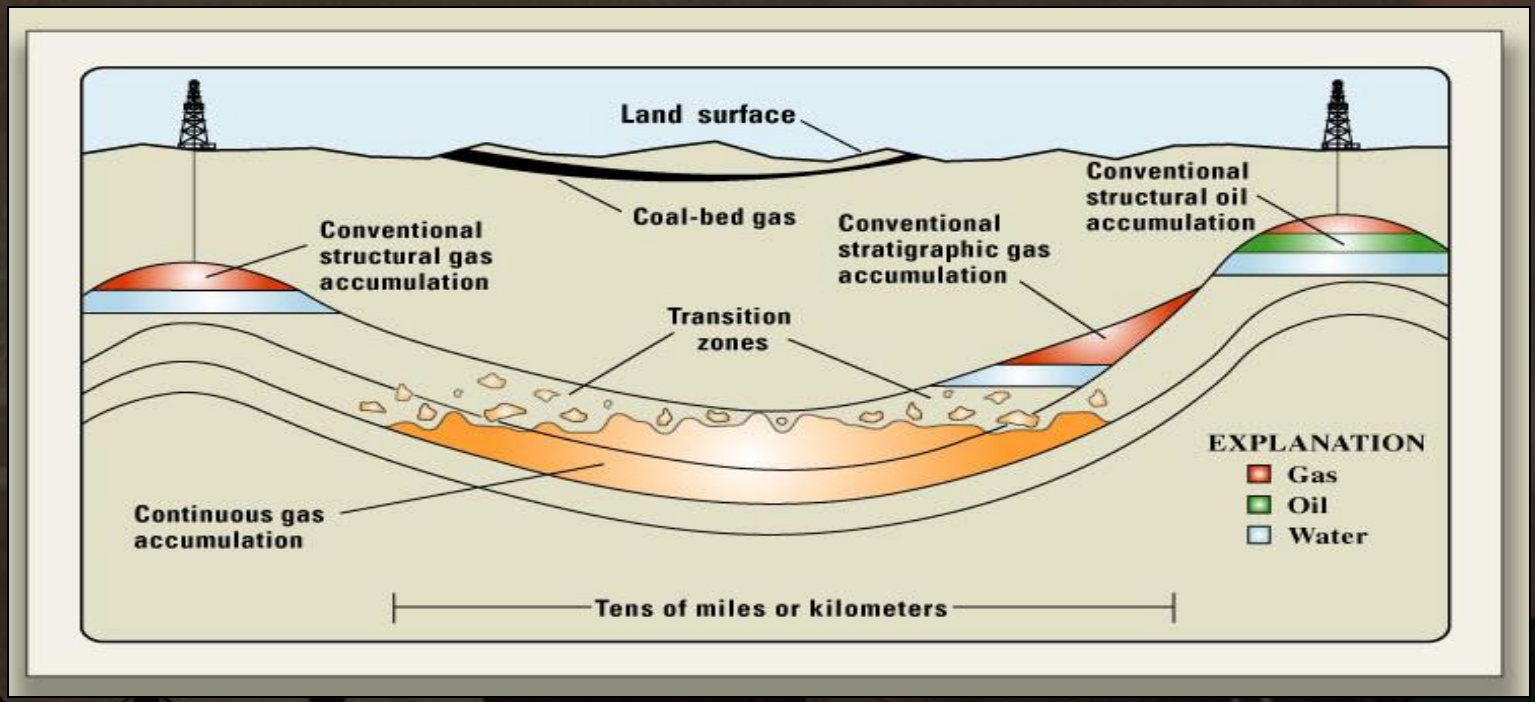
Dr. Marcia McNutt
Editor in Chief, *Science*

American Association for the Advancement of Science, Washington, D.C.

Unconventional Resources

an important part of the national energy potential





New Challenges: “The Fracking Debate”

- Consumptive water use
- Induced seismicity
- Potential for aquifer contamination
- Landscape impacts

New Challenges: “The Fracking Debate”

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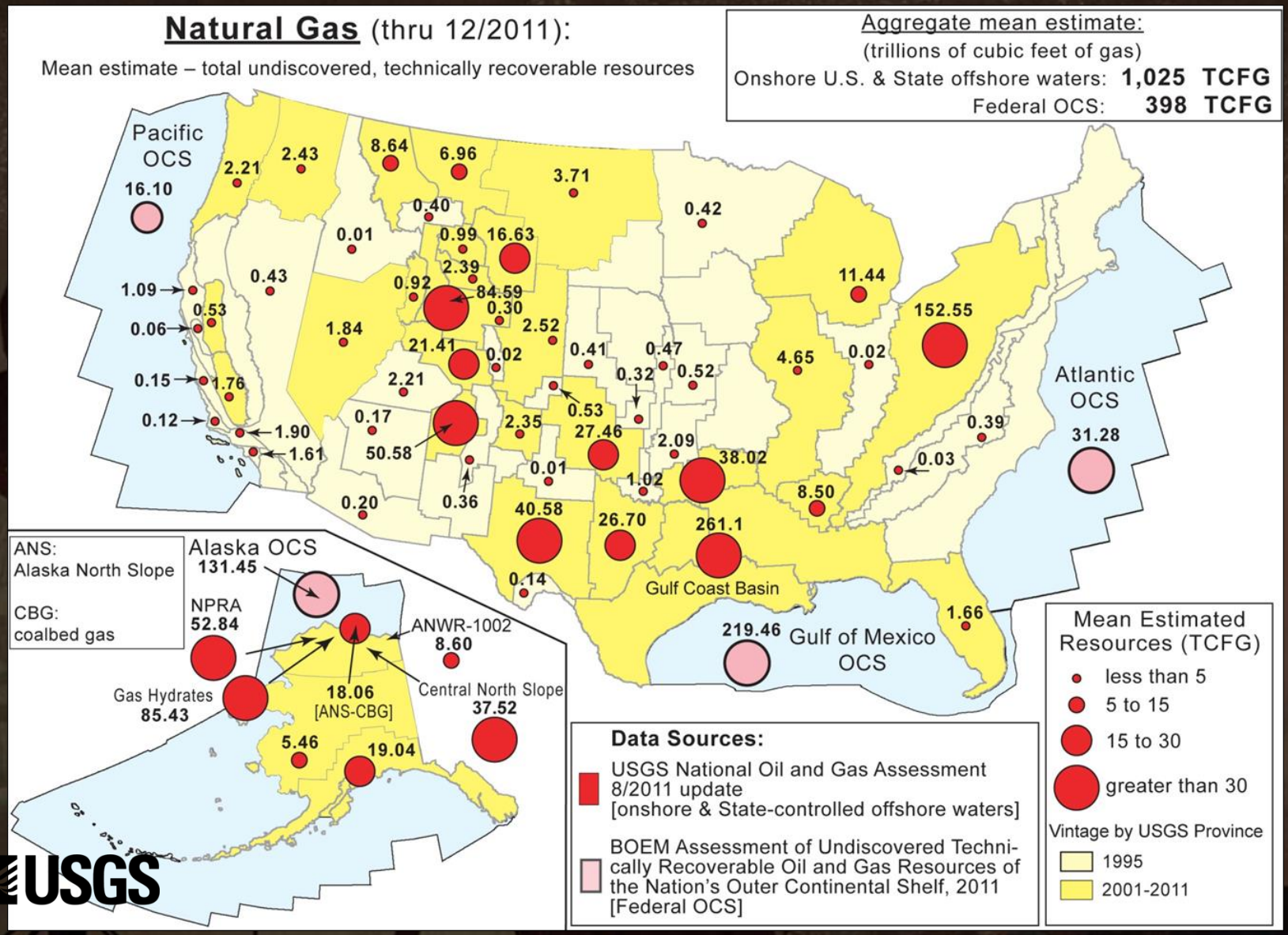
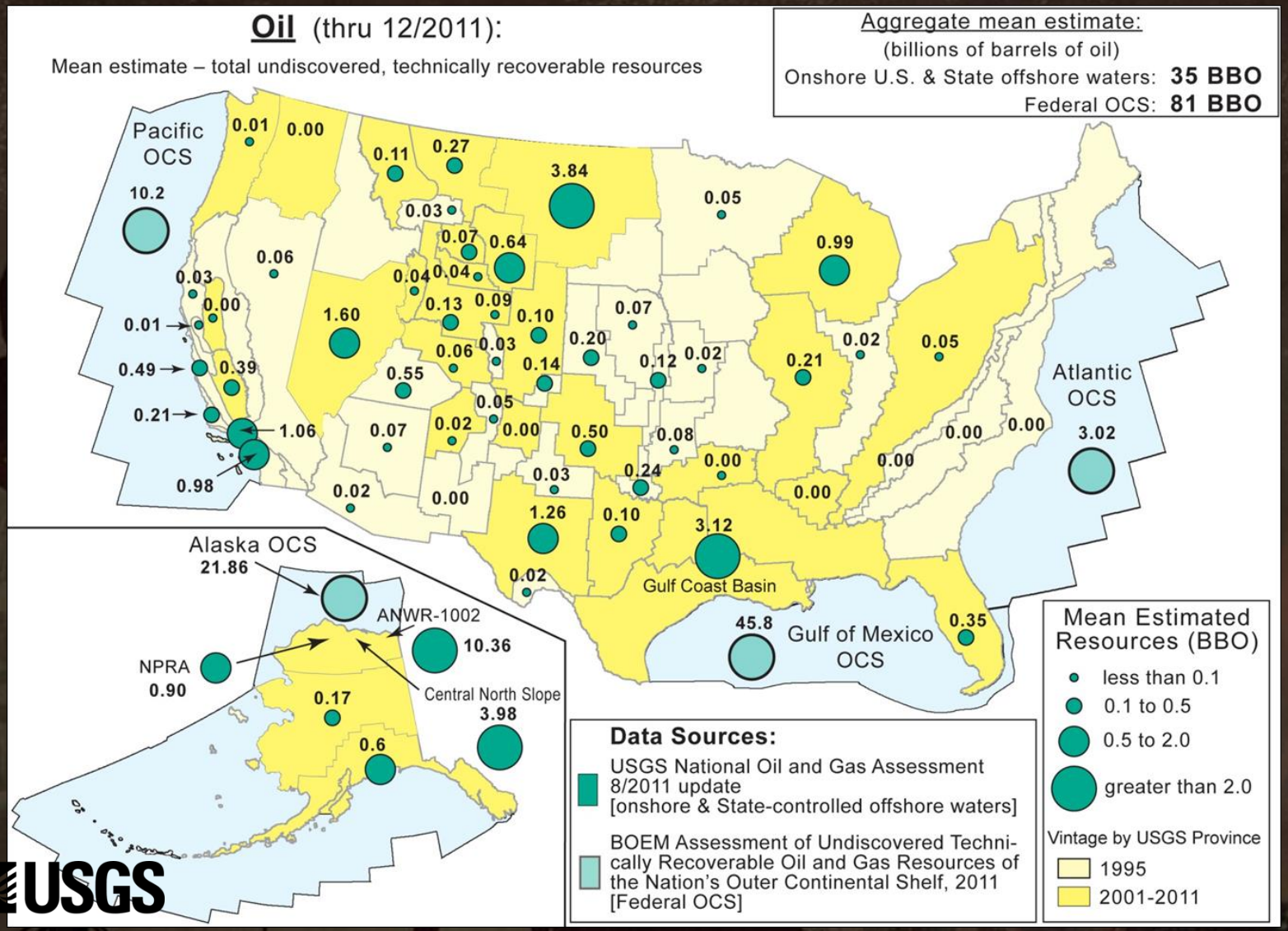
Establishing Anthropogenic Cause

- Do you know the natural baseline?
- Is there a mechanism that can connect the anthropogenic action to the environmental effect?
- Is there a temporal connection between the anthropogenic action and the environmental effect, accounting for known lags?
- Is there a “smoking gun”?

Where are the Resources? Unconventional Gas



Where are the Resources? Unconventional Oil



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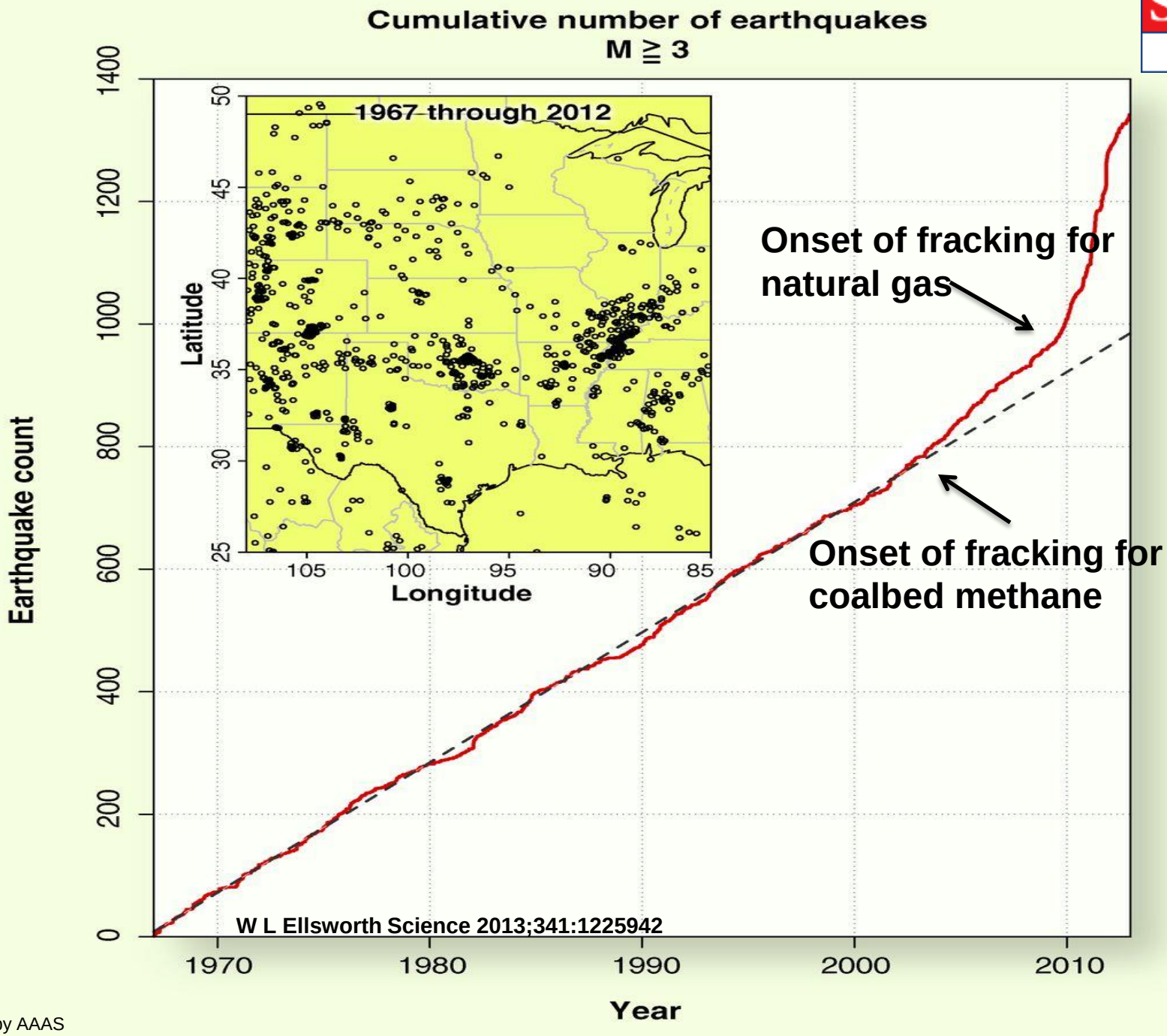

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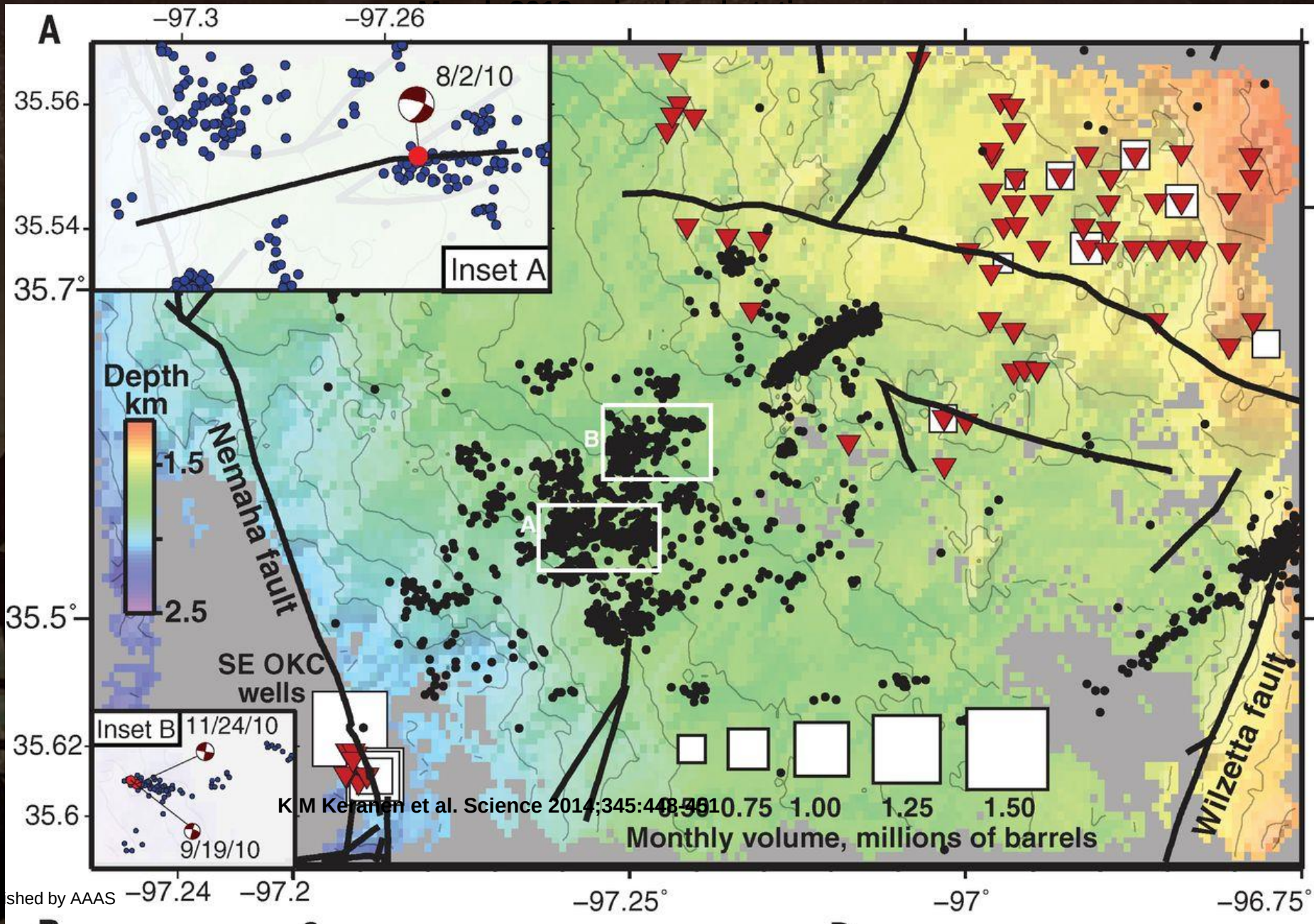
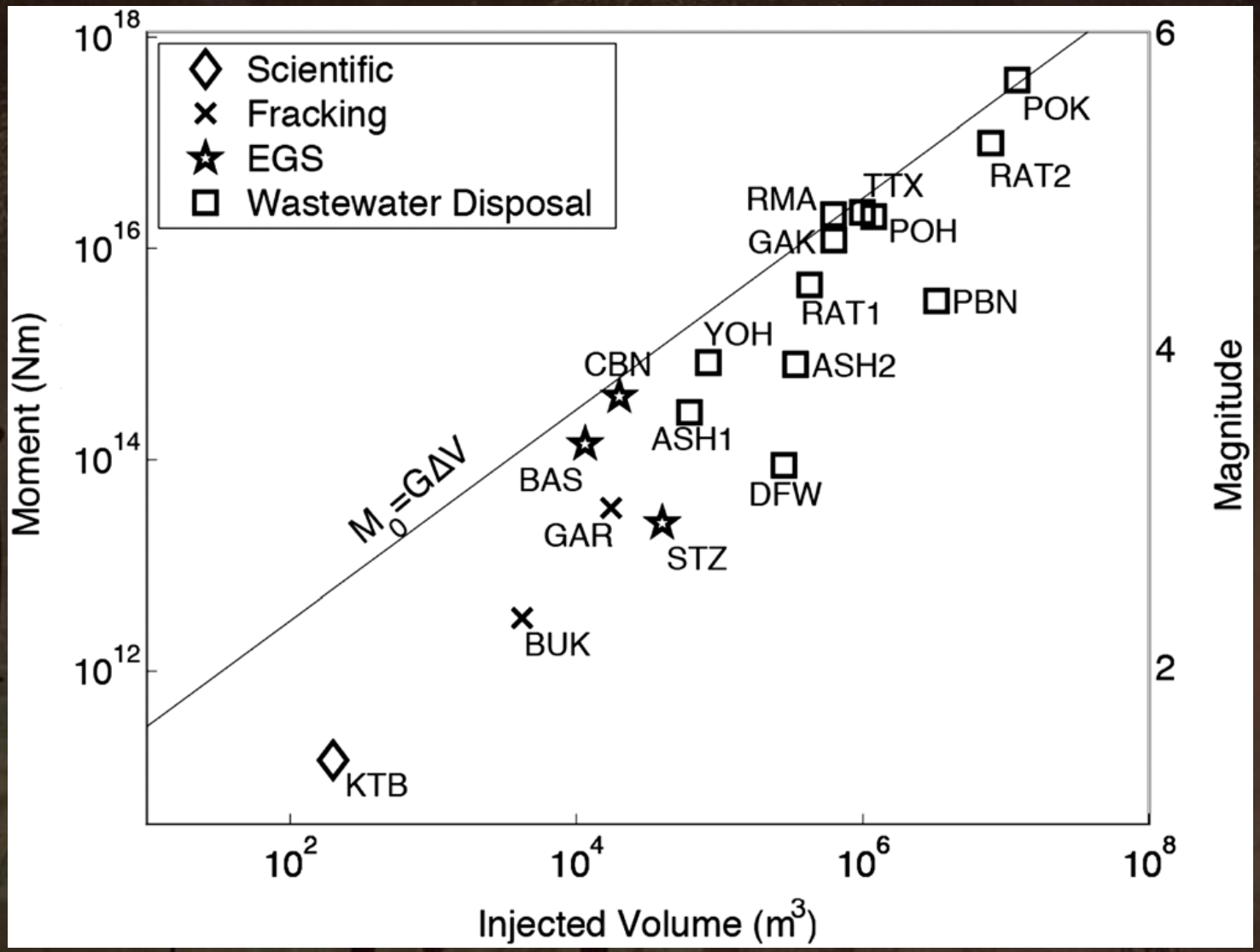
Fig. 2 Earthquake catalog and swarm migration.(A) Jones earthquake catalog Marc



K M Keranen et al. Science 2014;345:448-451

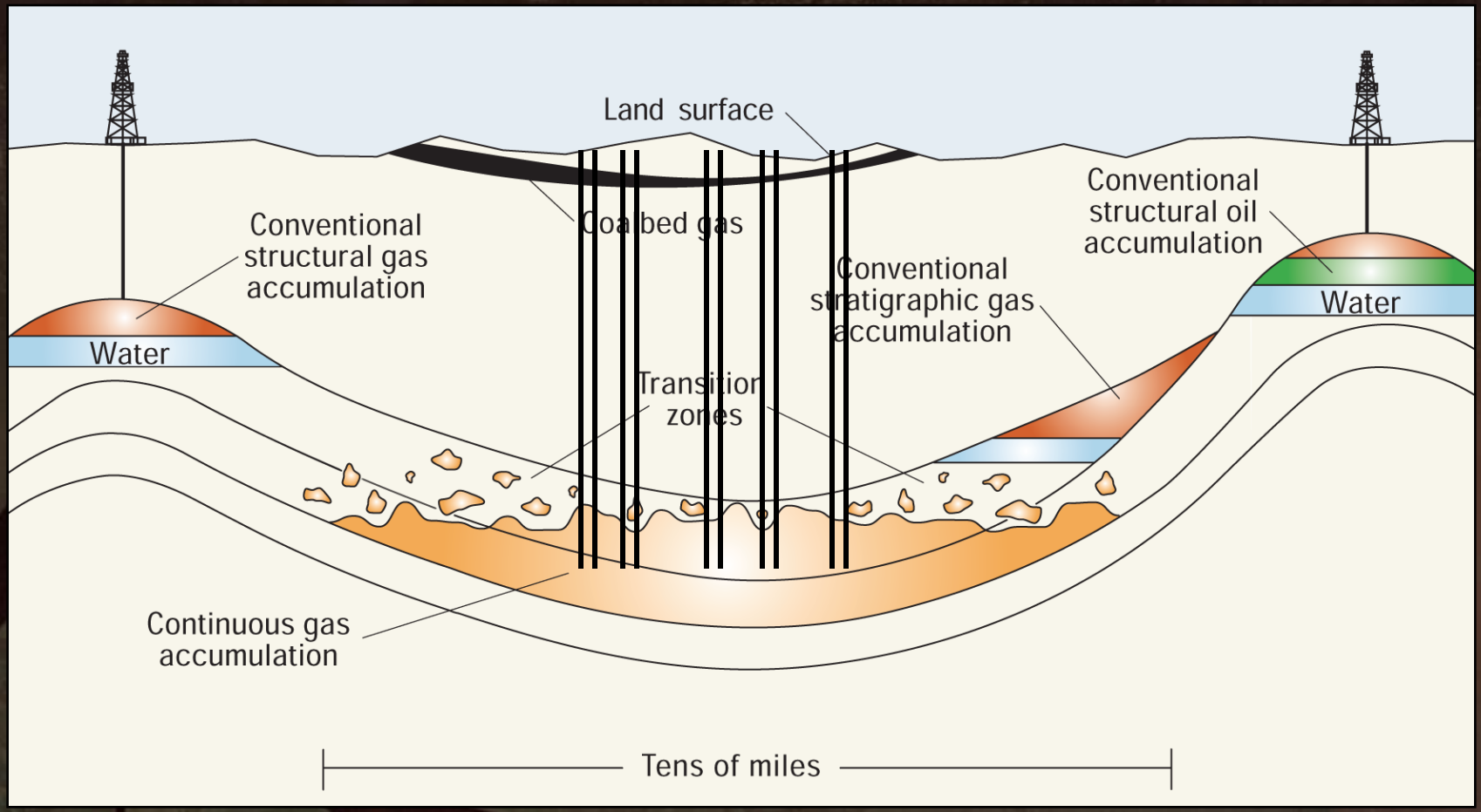


From McGarr, JGR, 2013

Reducing Uncertainty on Cause and Effect

- More dense seismic arrays to constrain earthquake locations and depth
- Industry information on timing, rate, and amount of fluid injection in wastewater injection wells (Both would connect temporal relation and confirm physical mechanism)

Water Impacts from Fracking



Troubled Waters

Groundwater contamination was found near Pavillion, Wyo.

25 miles

Pavillion

87
25

Casper

Gas field
Oil field

Source: EPA

Problems Connecting Cause and Effect with Water Contamination

- Lack of pre-production baseline on water quality (Getting natural baseline)
- Constituents in fracking fluids are proprietary and not uniquely diagnostic (the “smoking gun”)

Effect of Uncertainty is Relative