

**HYDRAULIC FRACTURING IN CALIFORNIA:
ENVIRONMENTAL ISSUES WITH THE LARGEST SHALE OIL FORMATION IN THE U.S.**

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Sponsor: Division of Environmental Chemistry

This symposium will contain the latest information on hydraulic fracturing (fracking) including the technical challenges, environmental effects, and political and regulatory climate. Existing shale plays in the U.S. will be discussed and particular emphasis will be placed upon California's Monterey Shale formation. Significant environmental concerns have been raised at fracking locations throughout the U.S. The injection of millions of gallons of drilling fluids with toxic additives in boreholes extending for miles to crack the shale and release oil and methane has led to claims of contaminated water supplies, releases of chemically contaminated flowback fluids, air pollution, increased greenhouse gas emissions, and induced earthquakes.

Proponents of domestic energy development note that U.S. imports of oil have dropped significantly to their lowest point in the last 20 years and U.S. need for imported oil has declined from 60-70% consumption to 40% and declining. Oil imports dropped 41% in 2012, largely replaced by the light sweet crude from North Dakota's Bakken Shale deposits. Proponents also note that fracking technologies have been in use in the U.S. for the last 60 years, that it is a fundamentally safe technology, and that multiple government studies have not identified widespread environmental contamination. Development of U.S. domestic oil shale is described as part of the equation to achieve North American oil self-sufficiency by the end of the decade. As one expert put it "Shale deposits are a gift from God."

The Monterey Shale formation is estimated to hold one of the world's largest onshore reserves of oil shale and more than half of the undeveloped, technically recoverable oil shale deposits believed to exist in the continental U.S. Recently, government studies have revised upward the oil volume estimates of the Monterey Shale formation to as much as 15.4 billion bbl of oil, more than double the volume of the Bakken Shale and greater than five times the volume of the Eagle Ford Shale in Texas.

The Monterey Shales are a vast complex geology of fractured, folded, and faulted rock formations, covering 1,750 square miles of central and So. California. At 1,900' thick and over 11,200' deep the geologic complexities render the formation more difficult to access than the 22' thick, 6,000' foot deep uniform Bakken Shale covering 6,500 square miles of North Dakota and Montana. The fracking industry is working to identify the locations and amounts of sequestered oil and the best way to extract it from the Monterey geology. However, no operator has "cracked the code" for the Monterey Shale.

Fracking fluids can potentially contaminate drinking water aquifers through releases from improperly or faulty constructed fracking wells and there have been reports of contaminated drinking water supply wells in the vicinity of fracking operations. During fracking 1-3 million gallons or more of a water, sand and additive mixture are injected under pressure into the formation to fracture the shale. There are over 2,500 fracking products containing 750 different chemicals and other components in use. Some fracking chemicals are

toxic and can potentially absorb methane and formation materials such as heavy metals, radionuclides, brines, and organics, returning the compounds to the surface in flowback fluids. Reports indicate that up to 20%-85% of the fracking fluids can remain underground.

The complex geology and injection of millions of gallons of drilling fluids with toxic additives in a region that relies heavily upon groundwater for a significant amount of its drinking water resources are not the only significant challenges for industry to surmount before hydraulic fracturing can begin in the Monterey Shale. The bigger challenge will be surmounting a highly regulated California system and the court of public opinion that can be vehemently opposed to any oil resource development in the state. California, although currently the 4th largest oil-producing state, after Texas, North Dakota, and Alaska, is a very late player in shale oil development. Texas began developing their shale resources over 20 years ago and Pennsylvania seven years ago. California is described as being caught flatfooted in the shale renaissance and is only now rushing to develop regulations for hydraulic fracturing with Governor Jerry Brown in support of production from the Monterey Shale.

Hydraulic fracturing is a timely and significant issue in California. This symposium will be an opportunity to explore the results of ongoing research and consider the multidisciplinary approaches needed to meet the challenges posed by this technology. Presentations on all related topics are welcome and some suggestions include:

- Water usage
- Environmental contamination in groundwater and flowback fluids due to fracking
- Fate and transport of fracking fluids in the environment (groundwater, surface water, atmosphere)
- Geochemical impacts
- Atmospheric processes
- Detection and quantification
- Geologic complexity of the Monterey Shale formation
- Lessons learned from fracking challenges in other locations
- Newly emerging compounds of concern and compounds in development for use in fracking fluids
- Regulatory issues and perspectives
- Public's and scientists' concerns regarding fracking

Abstracts for both oral and poster presentations will be accepted. Please submit abstracts at abstracts.acs.org. Abstract deadline is August 16, 2013. Further information can be obtained from either of the organizers listed below:

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