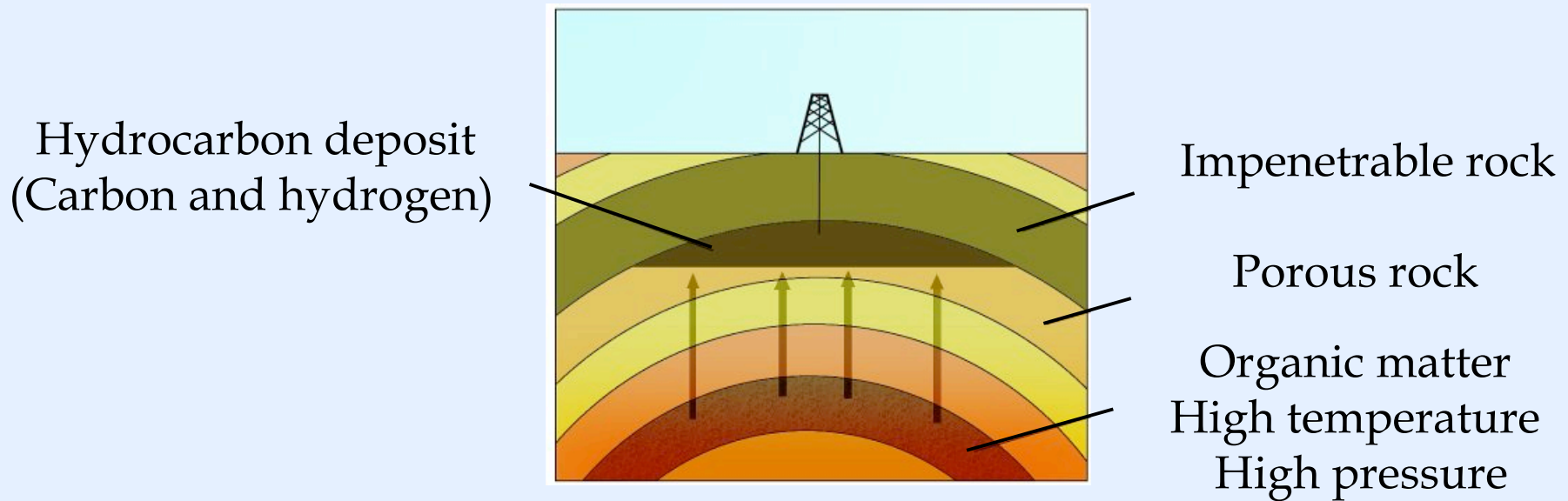


# Oil



Maria R. D'Orsogna

# Petr-oleum

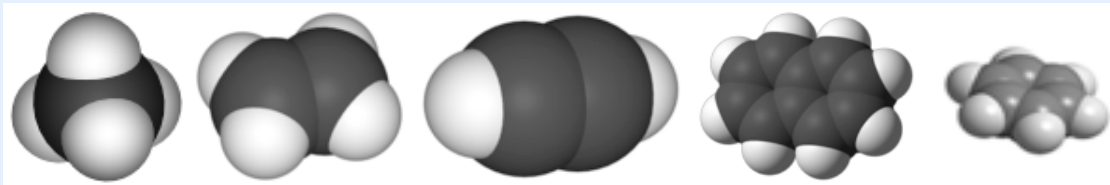


Mostly from the degradation of organic matter over millenia (zooplankton,algae)

Generate energy when burnt

NON RENEWABLE SOURCE

# Hydrocarbons



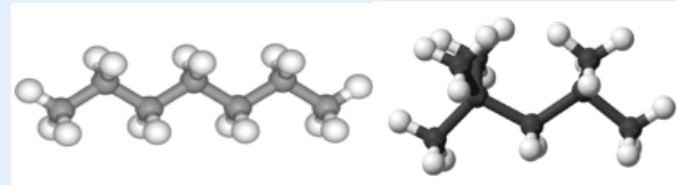
Methane  
 $\text{CH}_4$

Ethylene  
 $\text{C}_2\text{H}_4$

Acetylene  
 $\text{C}_2\text{H}_2$

Naphthalene  
 $\text{C}_{10}\text{H}_8$

Benzene  
 $\text{C}_6\text{H}_6$



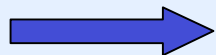
Heptane  
 $\text{C}_7\text{H}_{16}$

Iso-octane  
 $\text{C}_8\text{H}_{18}$

**GASOLINE**

gasoline, plastics, asphalt, lubricating oil

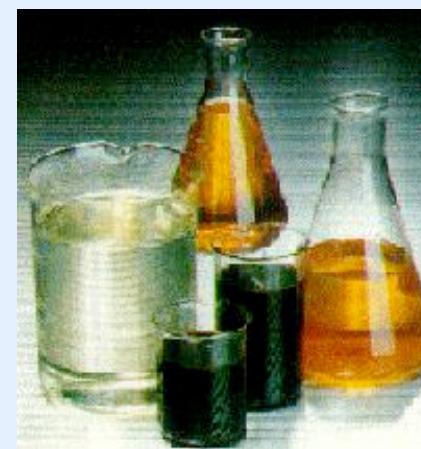
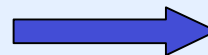
possible impurities



De-sulfurization

Distillation

Conversion



# History: Standard Oil

John. D. Rockefeller, Ohio

Sales, acquisitions, refinery and pipeline purchases, trusts

Standard Oil Co. of New Jersey vs. United States - 90% of the oil market

Ida Tarbell - the muckrackers - Mc Clure magazine

Sherman Antitrust Act 1911- Public outcry

34 new companies - Baby Standards

Exxon - Standard Oil of New Jersey

Mobil - Standard Oil of New York

Chevron - Standard Oil of California

# Today

“I am saddened that it is politically inconvenient to acknowledge what everyone knows: the Iraq war is largely about oil”

Alan Greenspan, 2007

“Of course it's about oil, we can't really deny that”

General John Abizaid, retired head of the US central command and military operations in Iraq, 2007 speaking of the Iraq war.

# 1. EXTRACTION

# Drilling muds and fluids



Eliminate rock cuttings, control pressure, sealants, lubricate, cool material, guide casing process

Secret chemical composition - hundreds of chemicals

Toxic (barium, cadmium, chrome, mercury, lead, zinc, arsenic, sometimes radioactive material...)

Difficult to dispose of

Waste waters and pits



# Drilling muds and fluids

Water-based muds or fluids (WBM)

Water, clay, chemicals - potassium and bentonite

Oil based muds (OBM)

Diesel fuels and other petroleum byproducts - more toxic

Synthetic based muds (SBM)

Less toxic than OBM

All are toxic, difficult to dispose of

Mud engineer, 10% of total costs

# Texaco's mess in Ecuador



<http://www.vanityfair.com/politics/features/2007/05/texaco200705?currentPage=all>

# Lago Agrio, Ecuador

The soil in the concession area has been found to be tainted with unusually high levels of chromium 6, cadmium, and barium—all toxic materials associated with the drilling and extraction process.



1,700 square miles of  
contaminated soil - 340 open pits

6 billion dollar clean up  
if ever

Pablo Fajardo

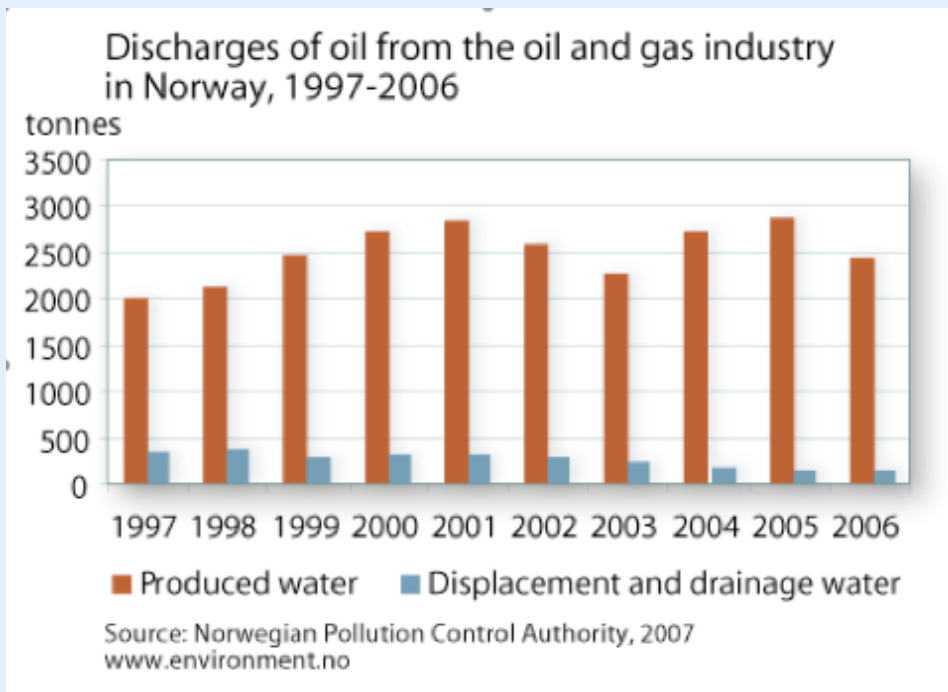
I realized that I was not inferior to the Chevron lawyers.  
In fact I had one advantage over them: I know the problems as they really are,  
because I live here. I have live here for more than half my life.  
I realized that if I took the case all I would have to think about is how to tell the truth.

# Water waste

Drilling fluids are **ORDINARILY** dumped in the sea

benzene, toluene, xylene, ethylbenzene, (BTEX), nitrates, cadmium, chrome, barium, arsenic, mercury, lead, zinc, copper

PRODUCED WATERS: salt, radon, biocides, anti-corrosives, hydrocarbons



# 'Normal' drilling - Gulf of Mexico



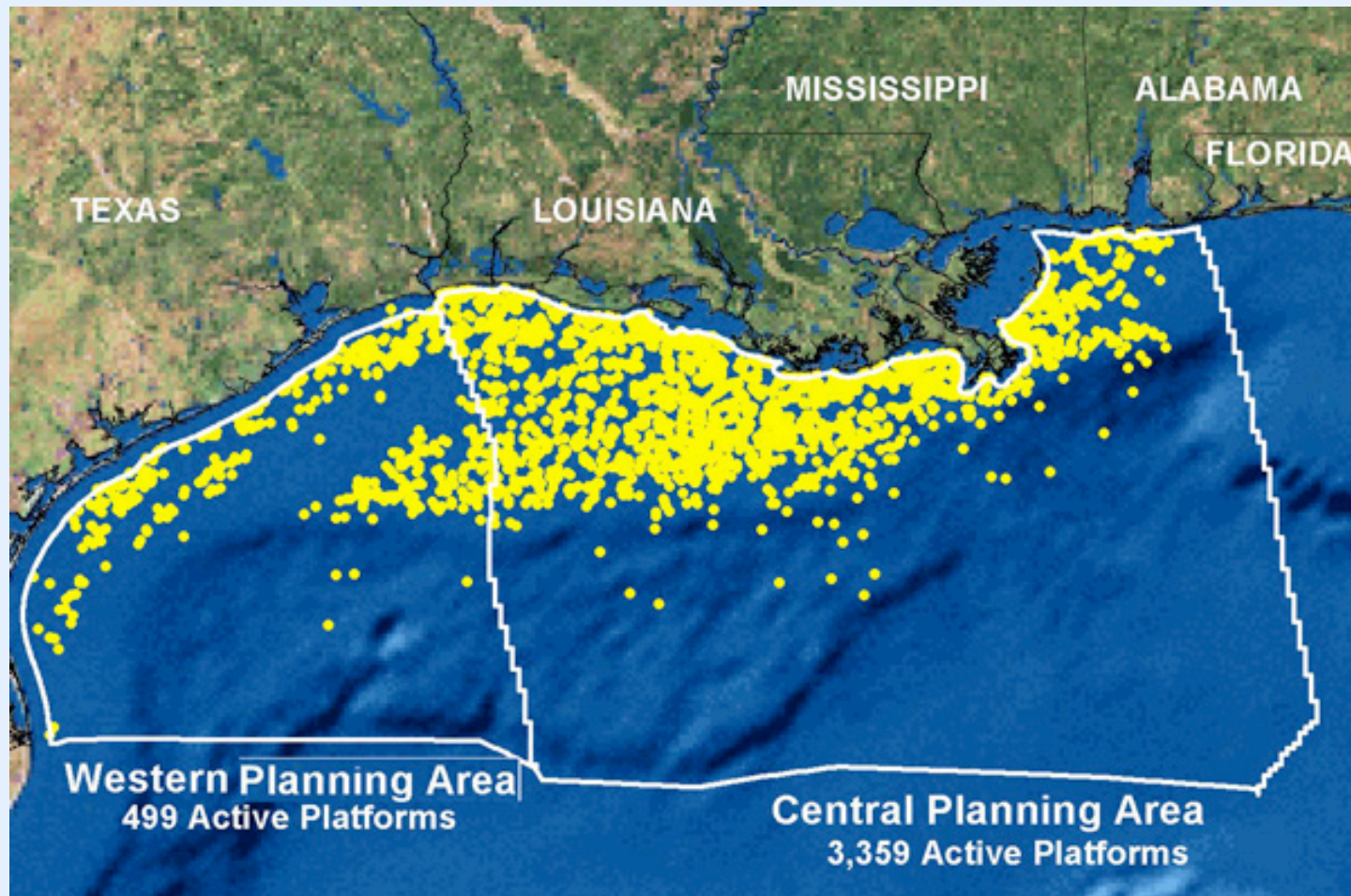
# Oceana

“Offshore rigs can dump tons of drilling fluid, metal cuttings, including toxic metals, such as lead chromium and mercury, as well as carcinogens, such as benzene, into the ocean.”

“The drilling waste, including metal cuttings, from exploratory drilling are generally dumped in the ocean, rather than being brought back up to the platform.”

# The gulf of Mexico

A Gulf of Mexico rig  
dumps about 90,000 tons of drilling fluid and metal cuttings over its  
lifetime, with its wells also contributing with heavy metals

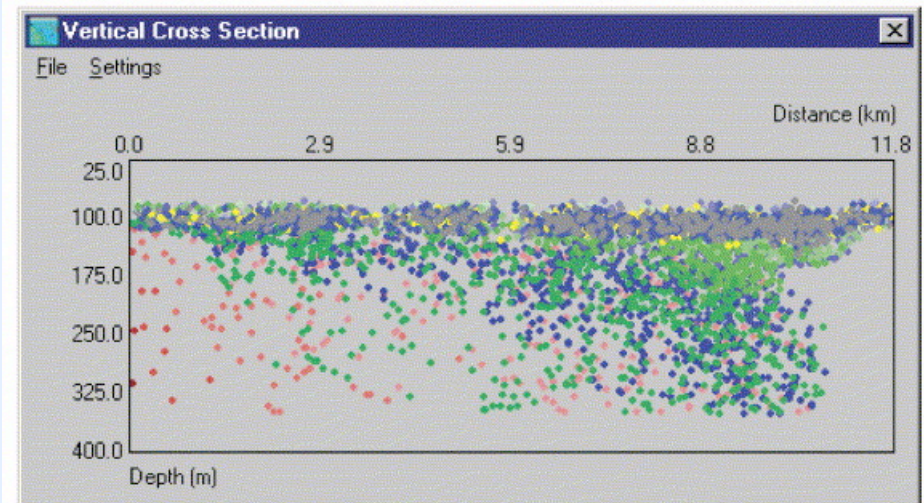
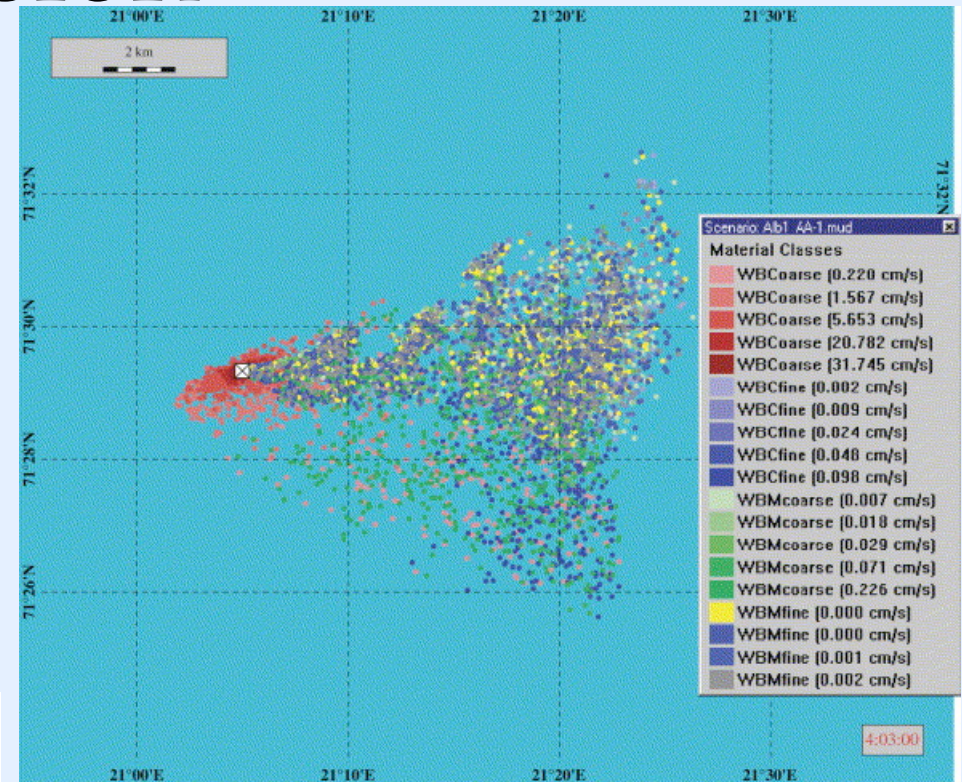
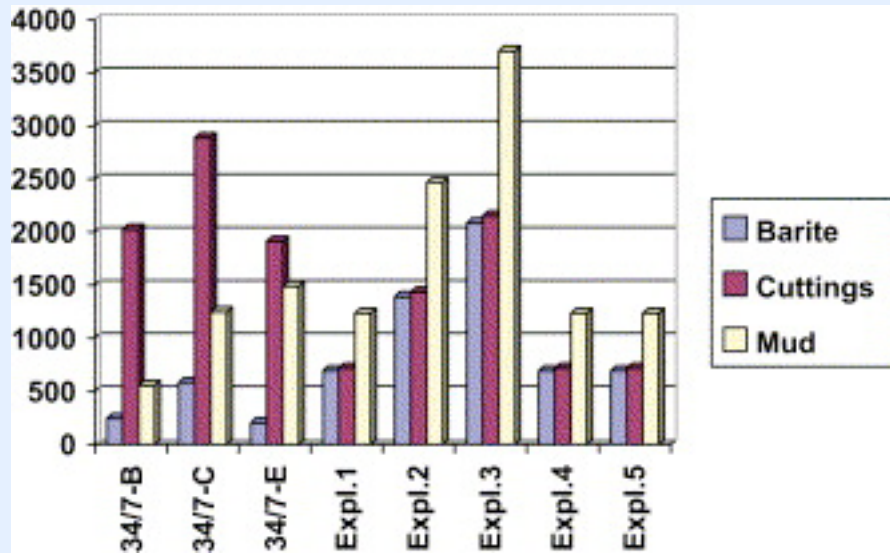


# Diffusion

Cutting can be dispersed over a range of several miles

Ryea et al Env Mod 21 (2006)

Exploratory wells





# Norwegian government:

Exploration activities and oil and gas production generate **LARGE EMISSIONS** of pollutants to air, water and the seabed.

Pollutants are released at **ALL STAGES** - oil and gas field operation, pipeline construction, transport of oil and gas and onshore processing.

It is **NOT POSSIBLE** for the oil and gas industry to operate efficiently without using large quantities of chemicals.

Chemicals are discharged together with drill cuttings, and are largely deposited on the seabed near the drilling rigs. However, the finest particles are **WIDELY DISPERSED** with ocean currents.

Traces of drilling fluids from the North Sea have for example been found as far away as the outer Oslofjord.

[www.environment.no](http://www.environment.no)

# Food and water watch

Recent reports have highlighted a connection between oil and gas rigs and elevated mercury levels in surrounding sediments and wild-caught fish. Data from a 1996 U.S. Department of Interior Minerals Management Service study of three rigs in the Gulf of Mexico revealed that sediments within a few hundred feet of two rigs had mercury levels many times higher than base levels in Gulf of Mexico sediments.<sup>5</sup> Data also indicated that shrimp and fish caught beneath the rig with the most contaminated sediments had average mercury levels that were two to five times higher than those caught around the least contaminated rigs.<sup>6</sup>

Scientists attribute the mercury contamination in and around the rigs to drilling „muds,”<sup>7</sup> which are a mercury-rich mixture of the sediments and materials that cool and lubricate drill bits that bore into the ocean and are ultimately discharged into the ocean.<sup>8</sup>

In 2001, federal guidelines limited the amount of mercury in drilling muds,<sup>9</sup> but approximately 1,600 pounds of mercury are still legally dumped into the Gulf of Mexico from the 1,091 new wells drilled each year.<sup>10</sup> High levels of mercury remain in sediments 12 years after drilling has stopped.<sup>11</sup>

<http://www.foodandwaterwatch.org/>

# GOOMEX report



Fish like oil rigs - can be contaminated



Bio  
accumulation

## SPECIAL REPORT

PRESS-REGISTER

### Rig shrimp test high for mercury

By BEN RAINES and BILL FINCH  
Staff Reporters  
01/27/02

A Mobile Register analysis of government data indicates that mercury levels in fish and shrimp caught near three gas rigs in the Gulf of Mexico mirror the elevated mercury levels in sediments beneath the rigs.

Shrimp caught near the most contaminated rig had average mercury levels at least 25 times higher than levels in shrimp samples from Mobile Bay and the Mississippi Sound and at least five times higher than average shrimp levels recorded in Galveston Bay, Texas.

Government records clearly state that drilling operations are responsible for surprisingly high mercury levels seen in sediments around those rigs.

The marine life tissue data, representing more than 700 separate samples of fish, shrimp, crabs and other sea creatures, was collected by scientists working for the federal Minerals Management Service, which is charged with overseeing the U.S. oil and gas industry.

The data was used to support the conclusions of the first phase of the massive MMS Gulf of Mexico Offshore Operations Monitoring Experiment, or GOOMEX, which is attempting to track the environmental effects of oil and gas wells in the Gulf.

*Oil rigs do not serve as natural, healthy habitat, but instead cook up a toxic soup for the marine life unknowingly attracted to them.*

Linda Sheehan,  
California Coastkeeper Alliance

## **SPECIAL REPORT**

PRESS-REGISTER

### **Mercury concerns hit West**

By BEN RAINES  
Staff Reporter  
04/07/02

In response to reports of mercury contamination at oil and gas rigs in the Gulf of Mexico, California's legislature is considering a bill that would require mercury testing around that state's offshore rigs in the Pacific Ocean.

The California bill, which is being pushed by the California commercial fishing association, also calls for an investigation into possible harm to humans who consume fish or shellfish caught near oil rigs.



# Flaring of excess gas

Flaring is a process by which unusable or excess natural gas is released by a pressure valve and burned releasing tonnes of carbon dioxide into the atmosphere.



# Nigeria - Ogoniland

These include nitrogen dioxide, sulphur dioxide, and volatile organic compounds like xylene and hydrogen sulfide. Carcinogens such as benzopyrene are also released. People exposed to these substances can suffer from a variety of respiratory problems, which have been reported amongst many children in the Niger Delta but have but have never been systemically investigated.

These chemicals can also aggravate asthma, cause breathing difficulties and pain, as well as chronic bronchitis.



# Ken Saro Wiwa

*"We have woken up to find our lands devastated by agents of death called oil companies.*

*Our atmosphere has been totally polluted,  
our lands degraded, our waters contaminated, our trees poisoned,  
so much so that our flora and fauna have virtually disappeared"*



# Nigeria - Ogoniland

In Nigeria in 1995 however, it appears that Shell's PR people slowly realized that their part in the hanging of Ken Saro Wiwa and eight other activists was a public relations disaster, and in the aftermath the company made various concessions to its critics, in a vain attempt to undue some of the damage it felt had been done to its brand.

One of the promises made was the announcement of an end to gas flaring.

# Nigeria - Ogoniland

Shell formally announced that it would stop gas flaring by 2008.

Interestingly, since 2000, gas flaring in the  
Niger Delta has actually increased  
(according to the 2005 Shell Sustainability Report).

The flaring continues to this day.

# Nigeria



# Nigeria



# Nigeria



# Halliburton and deepening roots of corruption in Nigeria



AND ALEX ECHIEJINA

## Halliburton to pay \$559 million to settle bribery probe



By [Anna Driver](#)

HOUSTON | Mon Jan 26, 2009 2:18pm EST

(Reuters) - Halliburton Co will pay a \$559 million fine to end an investigation of its former KBR Inc unit if the U.S. government approves the settlement, the largest penalty against a U.S. company for charges of bribery under federal law.

The U.S. government's probe of Halliburton related to construction and expansion of a gas liquefaction facility at Bonny Island in Rivers State, Nigeria, and other projects dating back as much as 20 years, Halliburton has said in regulatory filings.

In July, Halliburton said it had "reason to believe" payments may have been made to Nigerian officials by agents of its TSKJ consortium, which built the Bonny Island Facility.

The TSKJ consortium includes France's Technip SA, [Italy's](#) Snamprogetti and Japan's JGC Corp.

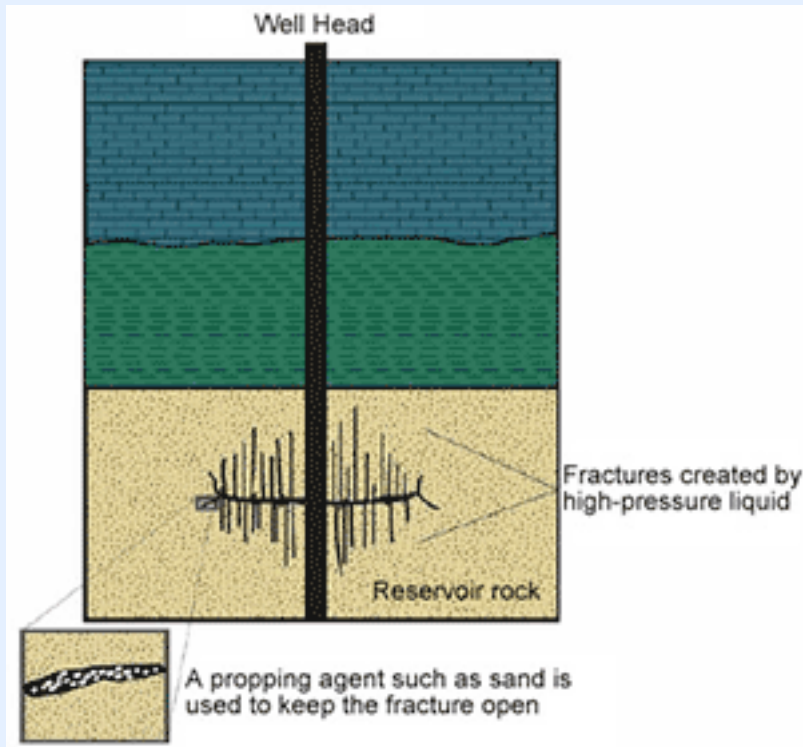
# Fracking - USA

Natural gas extraction method for deep well drilling.

Millions of gallons of water, sand and proprietary chemicals are injected into a well at high pressure

Fracturing of the rock props open fissures that enable natural gas to flow more freely out of the well.

Before fracturing methods were developed this gas was considered inaccessible



Gas well 8,000 feet  
Water well 1,000 feet

November 17, 2008 | 51 comments

## Drill for Natural Gas, Pollute Water

The natural gas industry refuses to reveal what is in the mixture of chemicals used to drill for the fossil fuel

By [Abrahm Lustgarten](#) and [ProPublica](#)

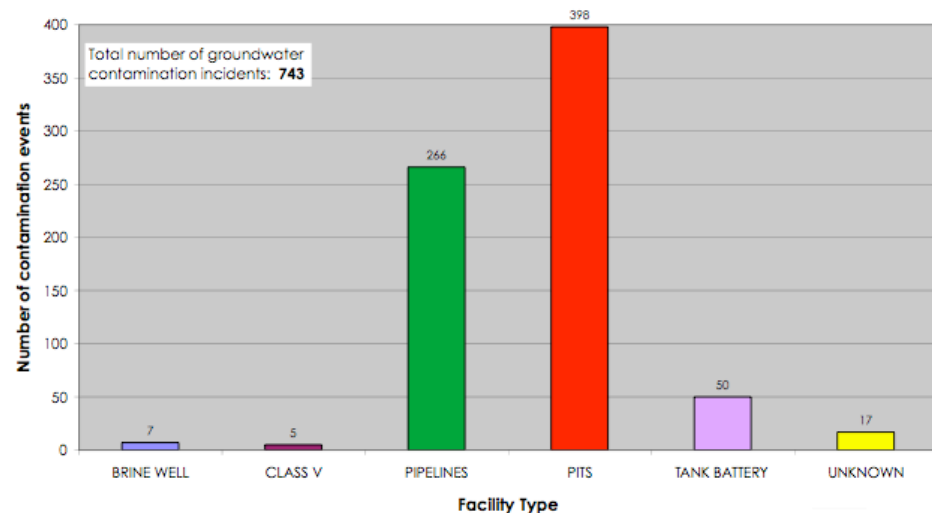
SCIENTIFIC  
AMERICAN

1000 water wells polluted  
in Pennsylvania, Colorado, New Mexico, Alabama, Ohio

New Mexico:  
743 pollution cases

Benzene and methane  
1500 times higher than average

Oil and Gas Industry Groundwater Contamination Events  
- by oil and gas facility type -



Data Source: New Mexico Oil Conservation Division.  
Ground water impact data available at:  
<http://www.emnrd.state.nm.us/ocd/statistics.htm>

Oil and Gas  
Accountability  
Project

# Gas drilling near upstate reservoirs imperils our water, Mayor Bloomberg says

BY [KATHLEEN LUCADAMO](#)  
DAILY NEWS CITY HALL BUREAU

Thursday, December 24th 2009, 4:00 AM



## NYC urges ban on shale gas drilling in watershed



[Edith Honan](#)  
NEW YORK

Wed Dec 23, 2009 3:45pm  
EST

### Factbox

[Shale gas stirs energy hopes, environment concerns](#)

Wed, Dec 23 2009

### Related News

[Q+A: Environmental fears over U.S. shale gas drilling](#)

Wed, Dec 23 2009

NEW YORK (Reuters) - New York City urged the state to ban natural gas drilling in its watershed on Wednesday, becoming the most powerful opponent to date of a process that critics say is poisoning drinking water.

U.S. | GREEN BUSINESS

# Gasland

In 1974, the Safe Drinking Water Act (SDWA) was passed by Congress to ensure clean drinking water free from both natural and man-made contaminants.

In 2005, the Bush/ Cheney Energy Bill exempted natural gas drilling from the Safe Drinking Water Act. It exempts companies from disclosing the chemicals used during hydraulic fracturing.

Essentially, the provision took the Environmental Protection Agency (EPA) off the job.

It is now commonly referred to as the Halliburton Loophole.

## 2. TREATMENT

# Types of oil

Light Crude - short molecules, few impurities

Heavy Sour - long molecules, high impurities, especially sulphur

API gravity index - the highest, the best

8 Tar Sands of Canada - the worst

40-45 Texas crude - the best oil, most expensive

Light crude oil  $\text{API} > 31.1$  (density is low and less than  $870 \text{ kg/m}^3$ )

Medium oil  $22.3 < \text{API} < 31.1$  (density  $870$  to  $920 \text{ kg/m}^3$ )

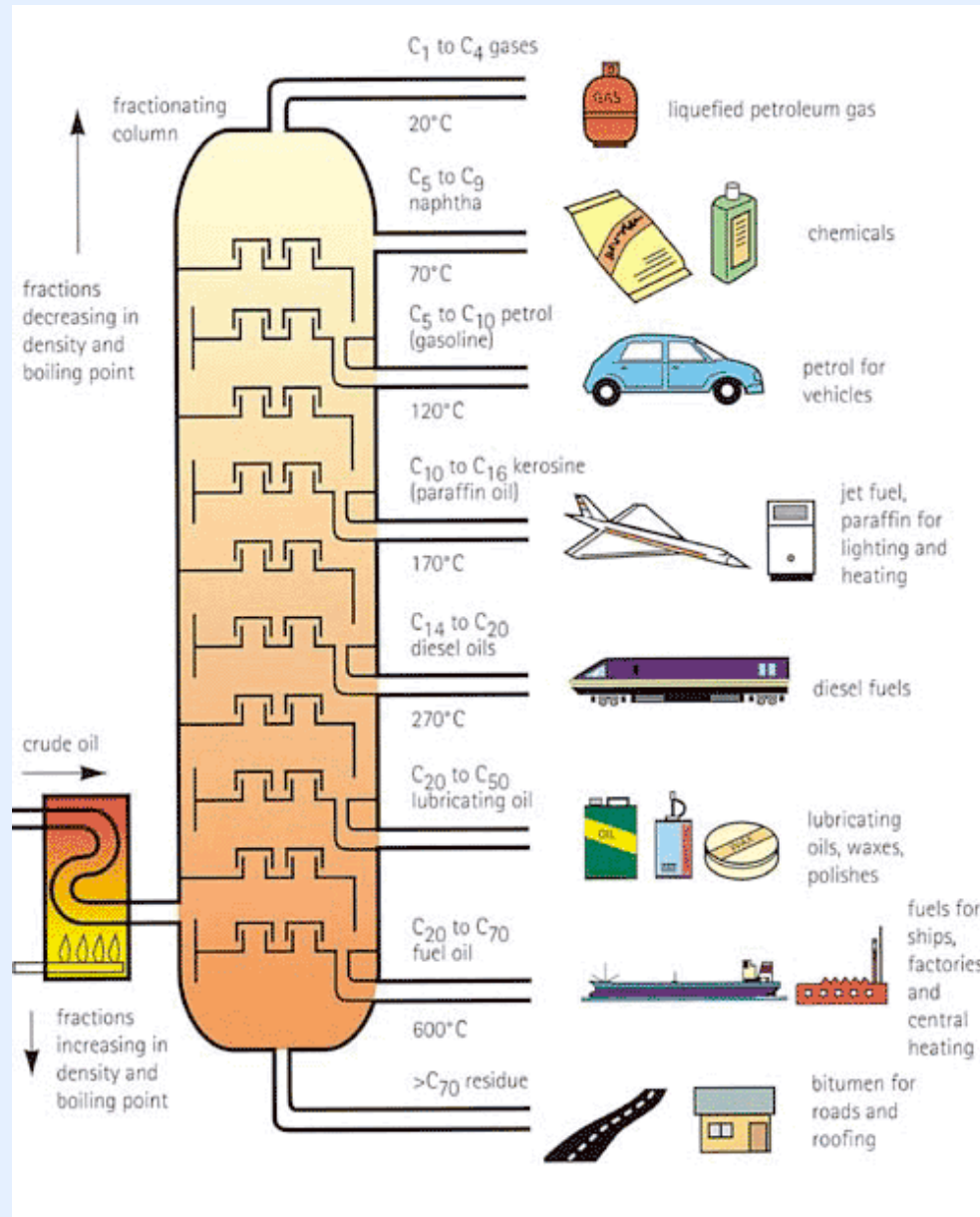
Heavy oil  $\text{API} < 22.3$  (density  $920$  to  $1000 \text{ kg/m}^3$ )

Extra heavy oil  $\text{API} < 10.0$  (density greater than  $1000 \text{ kg/m}^3$ )

# What goes on in a refinery?

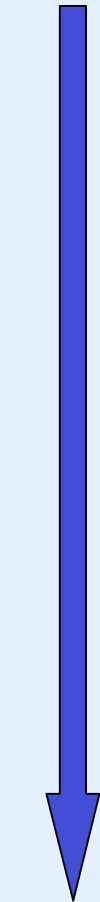


# Fractional distillation



Distillation column

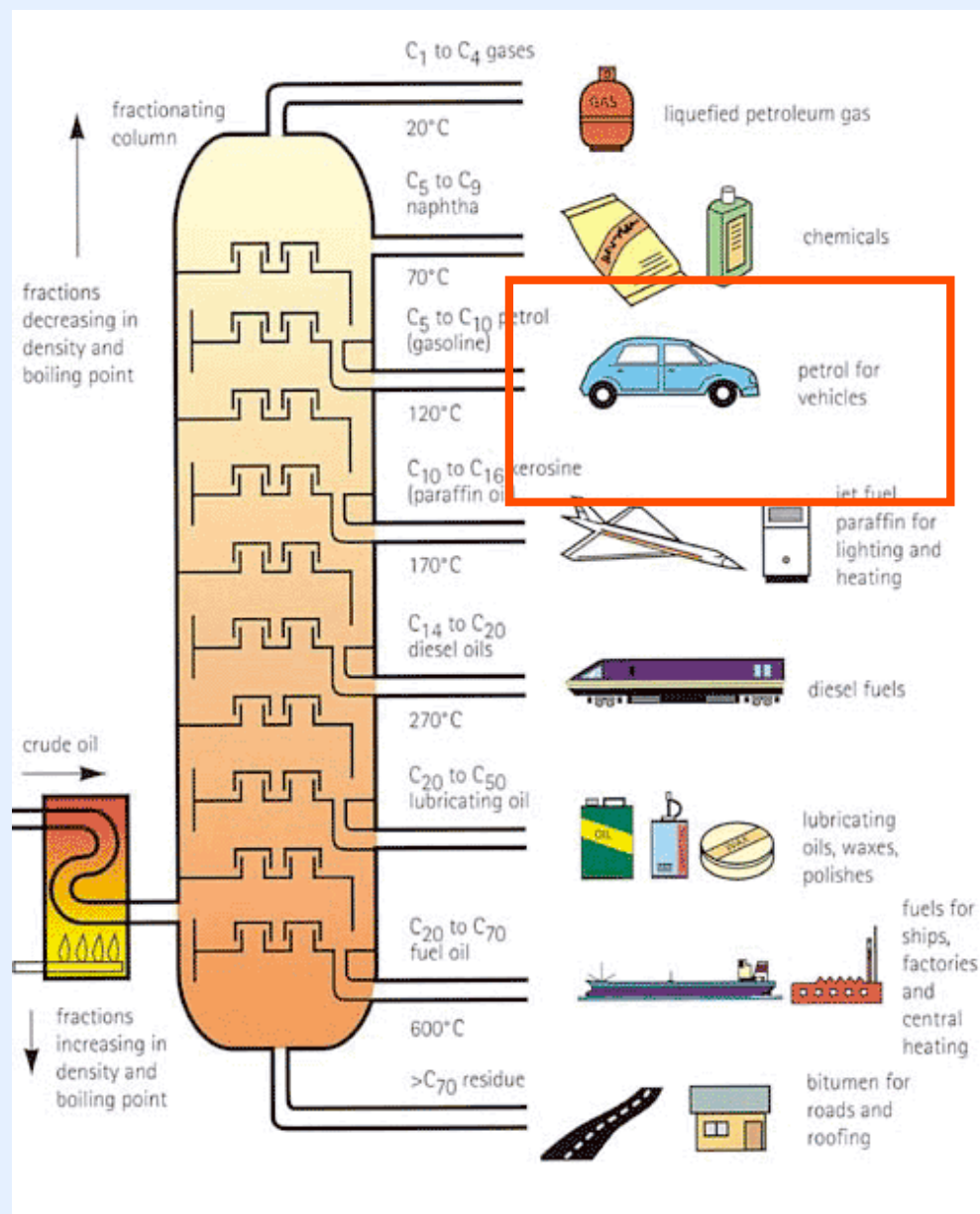
20 C



600 C

temperature

# Conversion



Sometimes longer molecules are broken apart (conversion or cracking).

Shorter hydrocarbons are worth more

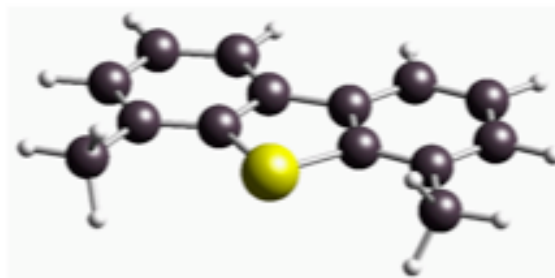
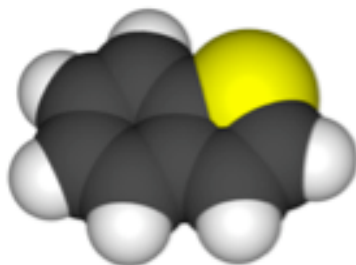
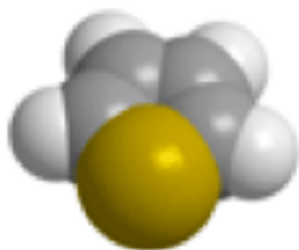
It is more desirable to have gasoline than asphalt

# Sometimes desulfurization

When crude oil has too many impurities  
(sulphur, nitrogen, minerals, salt)  
we need to eliminate them.

Sulphur is particularly nasty and undesirable.  
SOUR CRUDE

The desulfurization process occurs prior to  
distillation and cracking to get rid of sulphur



# Heavy Sour Crude

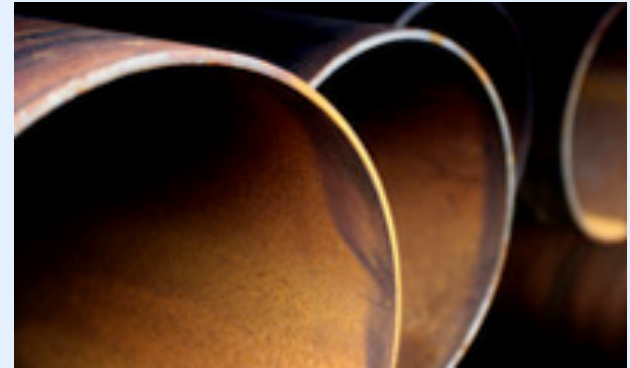
Low quality products

Very polluting  
(particulate matter, SO<sub>2</sub>, H<sub>2</sub>S)

Highly corrosive

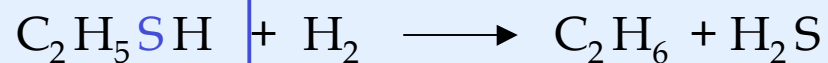
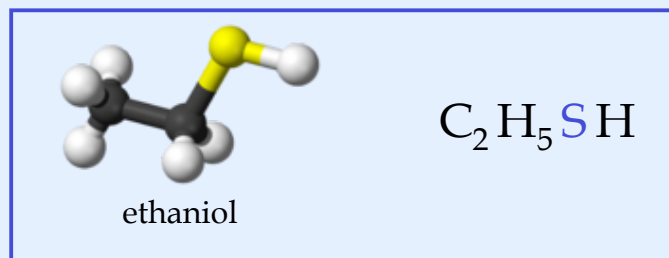
Viscous, not fluid, usually  
stinky, corrosive

Transportation is difficult



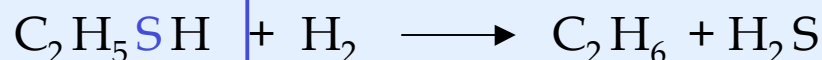
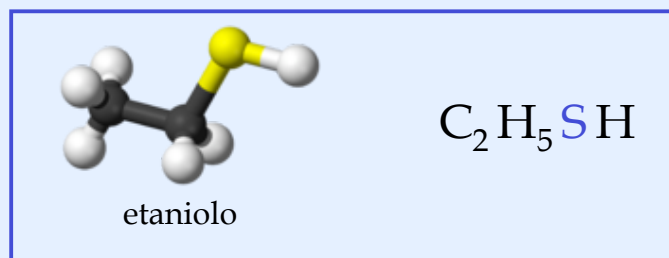
# Hydro-desulfurization:

Eliminate  
sulphur



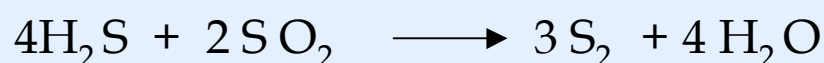
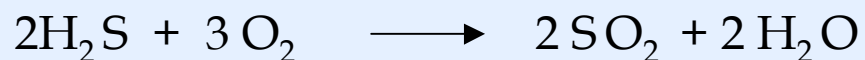
# Hydro-desulfurization:

Eliminate  
sulphur



Claus process:

Create  
elemental  
sulphur

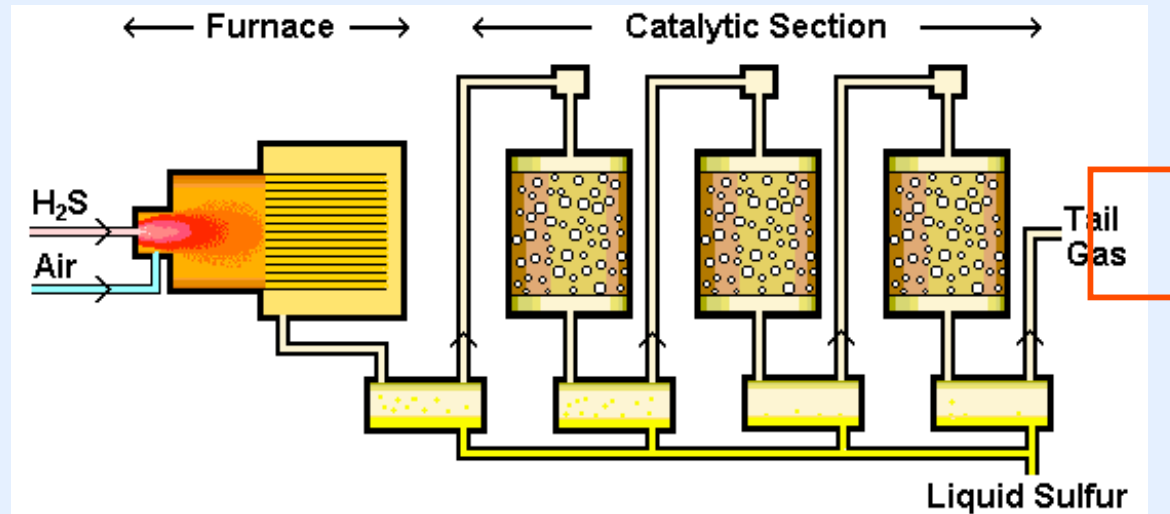


Highly flammable, catalytic and thermal  
processes, high pressure, high temperature  
(cobalt, molybdenum)



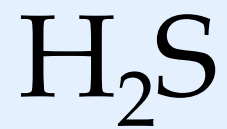
Sulphur

# Tail gases



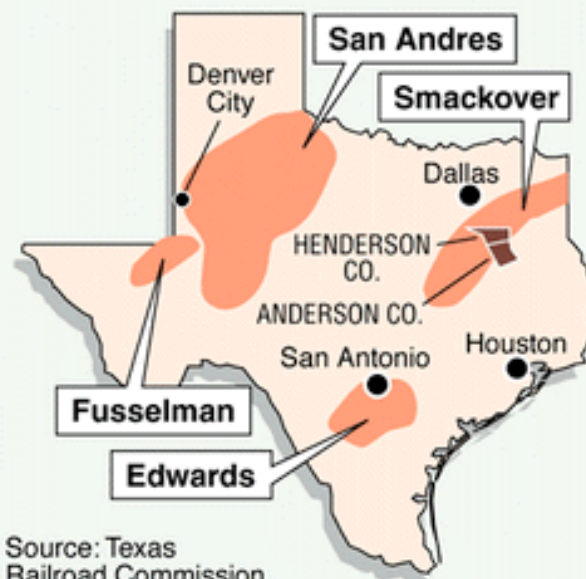
300 C, high pressure, water  
 $\text{H}_2\text{S}$  residuals, often burnt

$\text{H}_2\text{S}$  may also be present in  
gas or crude oil underground  
“sour gas”



## Sour gas in Texas

"Sour gas," so called because it contains deadly hydrogen sulfide, is present in four large oil and natural gas formations in Texas. They are:



# Houston Chronicle

<http://www.chron.com/content/chronicle/nation/h2s/>

[HoustonChronicle.com](http://HoustonChronicle.com)

## The Brimstone Battles

A Houston Chronicle Special Report



The red flag at the gate leading to an oil field near Pearsall, Texas, signifies the level of hydrogen sulfide danger at a well that caught fire after an explosion in July.

Stories by [Jim Morris](#)  
Photography by [Smiley N. Pool](#)

[Discussion Forum](#)

### INTRODUCTION

[An ancient poison and the price of progress](#)

### THE TOXIC BATTLEFIELDS

[DENVER CITY: Death came from a cloud](#)

A deadly cloud claimed the lives of nine people in 1975. What lessons have been learned?

• [Map: Sour gas in Texas](#)

[HAWAII: Poison in Paradise](#)

Residents fear their health and island paradise are threatened by industrial efforts to tap a volcano for geothermal energy.

• [Map: Volcanic reaction](#)

[ALBERTA: Burden of the Beasts](#)

Ranchers watch their livestock suffer, but industry says it's not to blame and government officials are seeking answers.

• [Map: Northern exposures](#)

[EAST TEXAS: One Man's Stand](#)

One man's crusade to protect the environment earns the ire of oil and gas companies.

[HYDROGEN SULFIDE](#)

A chronology of known effects through three centuries

### LOST OPPORTUNITY

EPA had its chance to regulate hydrogen sulfide

• [Locales differ; but similar tales of frustration heard](#)

• [H<sub>2</sub>S exposures \(15k chart\)](#)

• [Hard-hit cities \(46k map\)](#)

### DANGER'S SHADOW

Foul air draws ire; state enforcement called ineffective

• [State's bid to tighten rule wilts under industry pressure](#)

### PORK BARRELS AND POLITICS

Panhandle residents not so wild about hog operations

• [Some firms tackle the problem - after a prod](#)

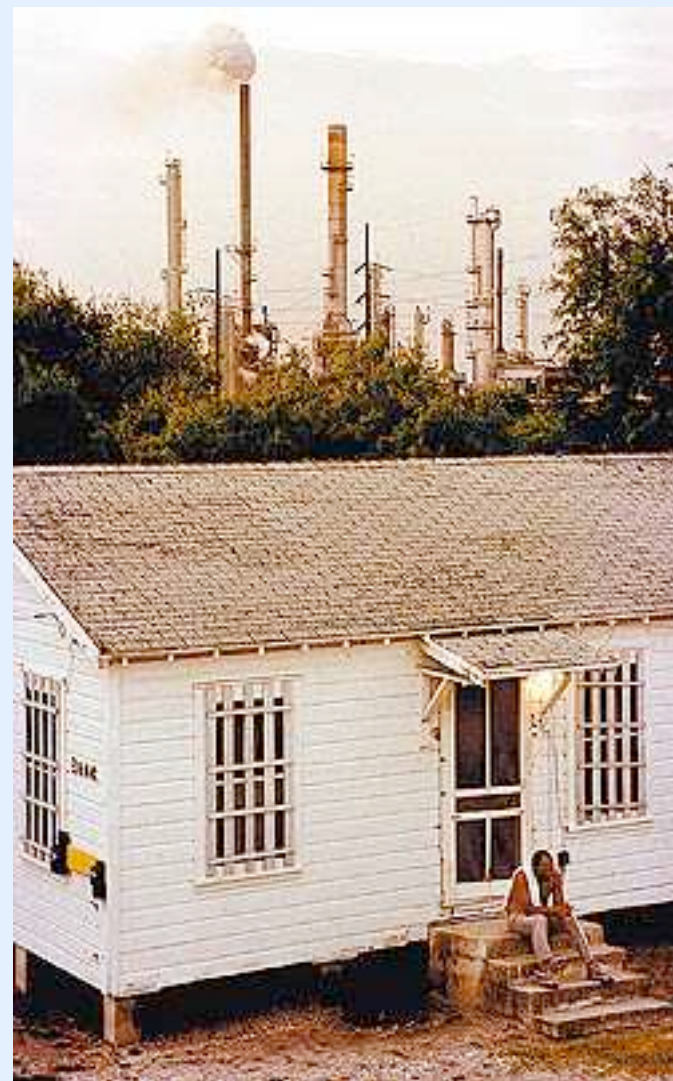
### New alarm over hydrogen sulfide

Researchers document lasting damage to human nervous system

# Refinery Row

A resident had called and complained of  
intense nausea,  
blaming it on an unidentifiable odor  
he assumed had come from one of the plants.

For Refinery Row, this was nothing new.  
The mostly poor people who are  
effectively stuck  
in the area had complained for years about  
repugnant odors, not to mention brilliant,  
smoking flares and ear-splitting noises.



# Refinery Row

Hydrogen sulfide (H<sub>2</sub>S) would pose a sizable public-health problem in Texas even if it were confined to Refinery Row, where an estimated 20,000 people are routinely exposed to it.

In fact, a Houston Chronicle investigation has found that the problem is much bigger. People in many parts of the state -- from the industrial neighborhoods of Pasadena, Beaumont-Port Arthur and Odessa to rural East Texas and the Panhandle -- have gotten little relief from a substance that is at best bothersome and at worst deadly.

In 1995, according to company estimates filed with the TNRCC, nearly **10 million pounds** of hydrogen sulfide were legally released by refineries, paper mills and other industrial plants in the state.

# Desulfurization at sea



# Floating Production Storage Offloading

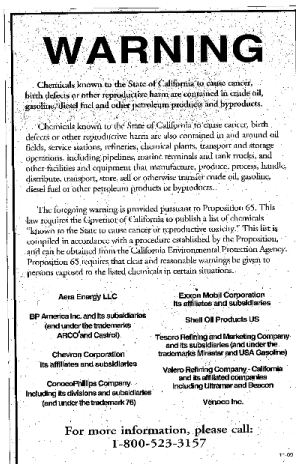


# Prop 65

Exxon-Mobil, Chevron, BP, Shell  
Los Angeles Times, 25 August 2010

CHEMICALS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER,  
BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM ARE  
CONTAINED IN CRUDE OIL, GASOLINE, DIESEL FUEL  
AND OTHER PETROLEUM PRODUCTS AND BYPRODUCTS.

Chemicals known to the State of California **to cause cancer, birth defects or other reproductive harm** are also contained in and around oil fields, service stations, refineries, chemical plants, transport and storage operations, including pipelines, marine terminals and tank trucks, and other facilities and equipment that manufacture, produce, handle, distribute, transport, store, sell or otherwise transfer crude oil, gasoline, diesel fuel or other petroleum products or byproducts.



### 3. ACCIDENTS

# Italy



1994 Trecate (Novara)

2-3 days uninterrupted  
Oil rain

50 km<sup>2</sup> farmland

Organic corn??

ENI

# Trecate, 1994:



# Trecate, 1994:



# Trecate, 1994:





# Offshore



About 500 every year  
Total clean ups almost  
impossible

Norway 1980,  
Exxon-Valdez, Alaska 1989  
Korea, 2007





Galicia, 2002  
India, 2005

Australia, 2009  
Egypt (ENI), 2004



# Exxon-Valdez, 1989



# Exxon-Valdez, 1989



## COLUMN ONE

### Exxon Valdez oil spill lingers in Alaska

In one fishing village, residents say they've never recovered from the 1989 disaster. Now the Supreme Court is hearing arguments on whether the company should pay \$2.5 billion in punitive damages.

By Tomas Alex Tizon

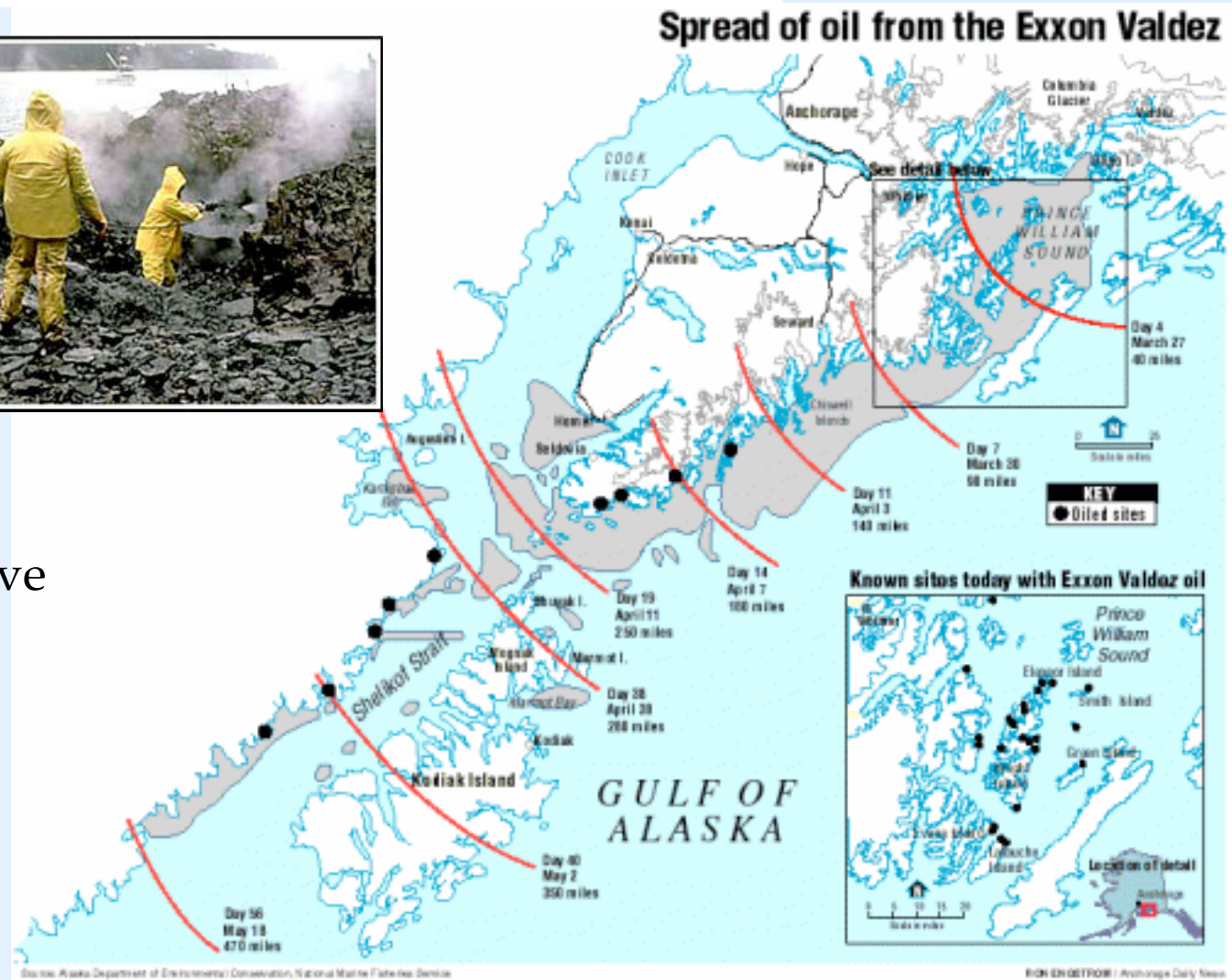
Los Angeles Times Staff Writer

February 27, 2008

2009



Fish populations have  
dwindled  
bankruptcies  
suicides



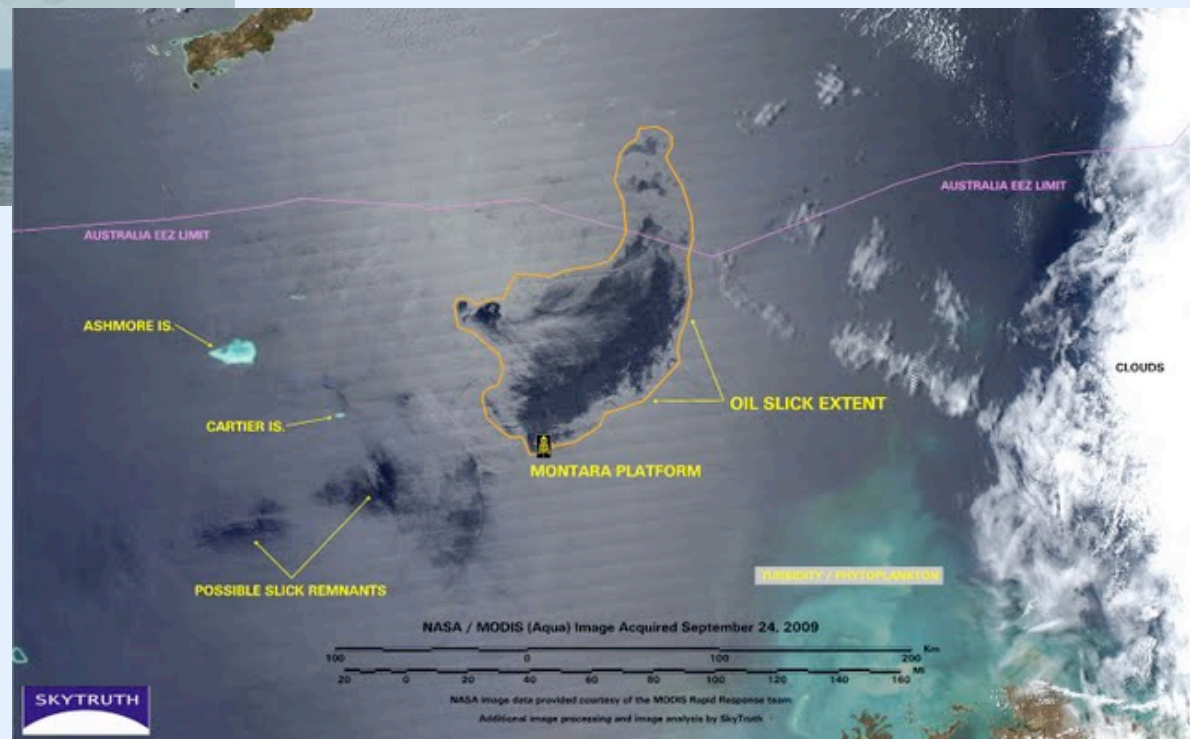
# Australia, 2009



Montara Oil Spill  
2 and a half months

Sky Truth

100 million gallons





Milazzo, Sicilia 2008



Genova, 2005



Falconara, AN 2004

Cremona, 2005

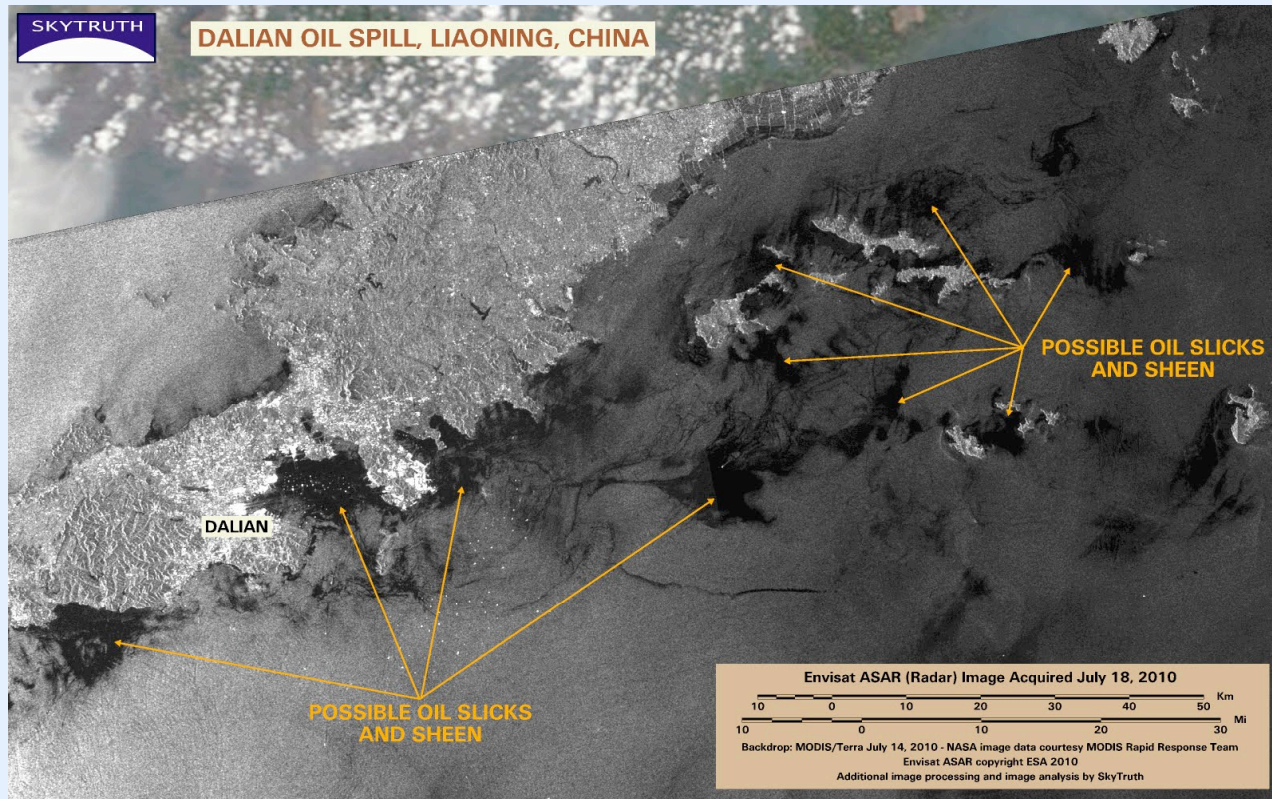


## Italian accidents

Falconara, AN 1999



# China, 2010



300 square kilometers

10 thousand fisheries

# Ravenna, Italy, 1960



# Lake Peigneur, 1980



The lake that disappeared

# Indonesia, 2004 - today



# Santa Barbara, 1969



# Santa Barbara, 1969



[http://www.geog.ucsb.edu/~jeff/sb\\_69oilspill/69oilspill\\_articles2.html](http://www.geog.ucsb.edu/~jeff/sb_69oilspill/69oilspill_articles2.html)

Nature writer John McKinney:

"I had been impressed by the way energetic college students, shopkeepers, surfers, parents with their kids, all joined the beach clean-up.

I saw a Montecito society matron transporting oily birds in her Mercedes."

McKinney witnessed the event firsthand as a volunteer who rescued oiled birds.

A chapter of his book *A Walk Along Land's End* describes his experience.

Fred L. Hartley, president of Union Oil Co.:

"I don't like to call it a disaster," because there has been no loss of human life.

**"I am amazed at the publicity for the loss of a few birds."**

Santa Barbara NewsPress Editor Thomas Storke:

"Never in my long lifetime have I ever seen such an aroused populace at the grassroots level. This oil pollution has done something I have never seen before in Santa Barbara – it has united citizens of all political persuasions in a truly nonpartisan cause."

U.S. President Richard Nixon:

"It is sad that it was necessary that Santa Barbara should be the example that had to bring it to the attention of the American people. What is involved is the use of our resources of the sea and of the land in a more effective way and with more concern for preserving the beauty and the natural resources that are so important to any kind of society that we want for the future.

**The Santa Barbara incident has frankly touched the conscience of the American people."**

Many credit the 1969 oil spill  
with igniting the environmental movement.

For eleven days, 200,000 gallons of crude oil  
spilled into the channel from a disabled oil rig.

In the aftermath, 3600 birds were dead along with ten  
seals and dolphins and countless fish and marine invertebrates.

[http://www.geog.ucsb.edu/~jeff/sb\\_69oilspill/69oilspill\\_articles2.html](http://www.geog.ucsb.edu/~jeff/sb_69oilspill/69oilspill_articles2.html)

# BP - Gulf of Mexico, 2010

Our greatest environmental disaster

20 billion USD and counting

250.000.000 gallons of oil

Questionable reports

Questionable dispersants

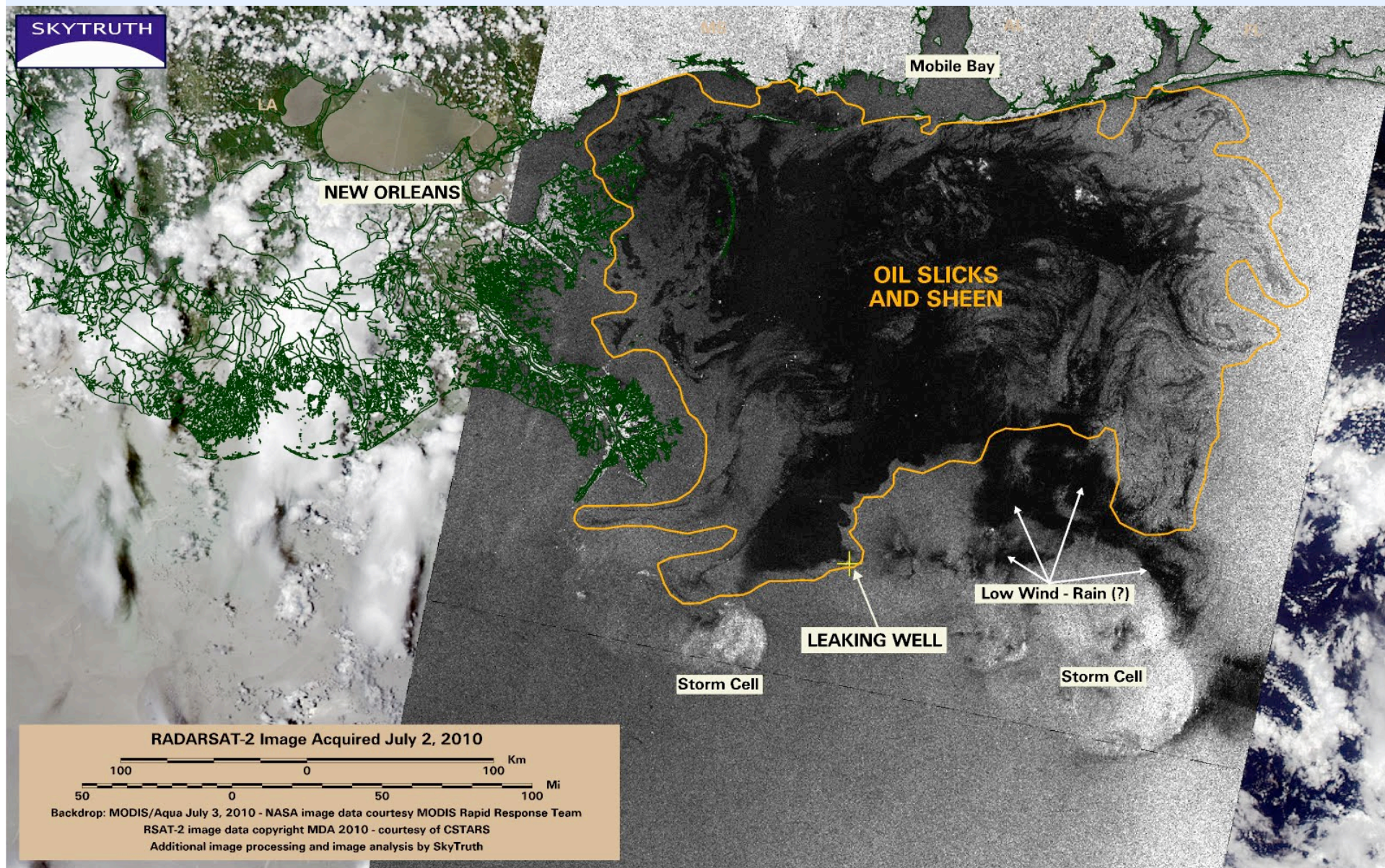
Questionable timescales

Ecosystem in shambles

11 dead

1 suicide

# 4 July 2010



















# 2011 - problems not over

## NATIONAL GEOGRAPHIC Daily News

[Home](#) [Animals](#) [Ancient World](#) [Energy](#) [Environment](#) [Cultures](#) [Space/Tech](#) [Water](#) [Weird](#)

### Odd Animal Deaths, Deformities Linked to Gulf Oil

Scientists befuddled by dolphin deaths, diseased fish.



# 2011 - problems not over



113 dolphins dead

Parasites on fish

Turtles, fish, crustaceans, corals

Deformed ovaries, missing finns, miscarriages

Genetic deformites, smaller sizes

Too soon to say

Oil- Corexit (dispersant) - deep water effects?

## 4. LAND SUBSIDENCE

# Subsidence

Porous rock/ saturated with HC

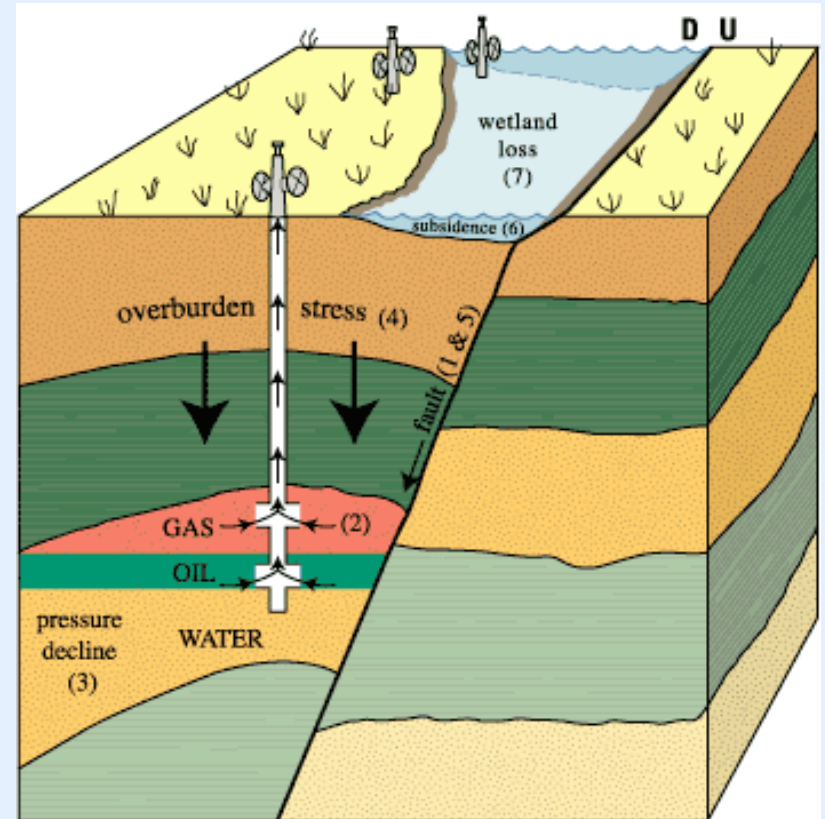
Extraction

Pressure drops - rock gets compactified

The land sinks

Can reactivate seismic faults

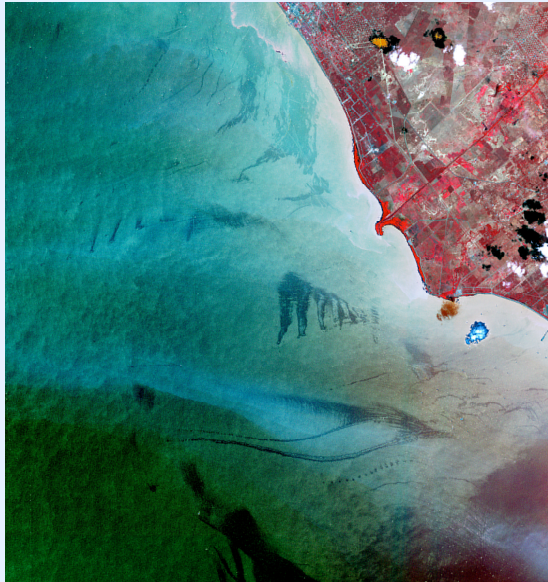
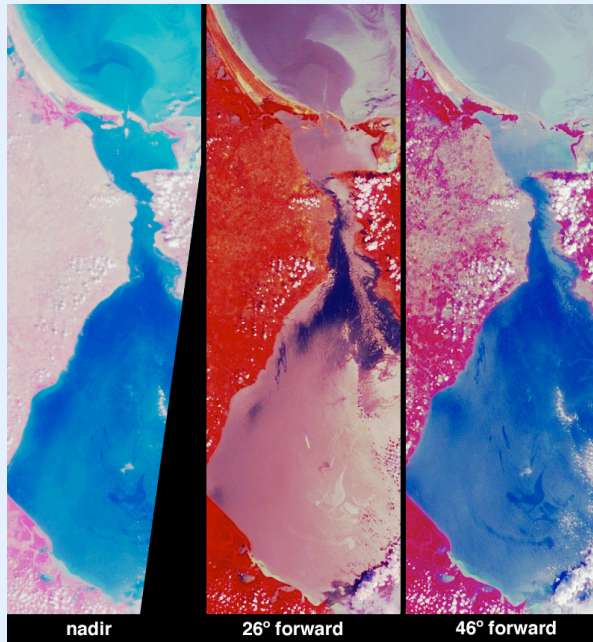
Can flood marshlands



2 - 5 km underground

**IRREVERSIBLE**

# Maracaibo, Venezuela



5 meters - 20 cm a year

Highly populated  
Inundation, lake is polluted  
Shaky dams

# Port Neches, Texas



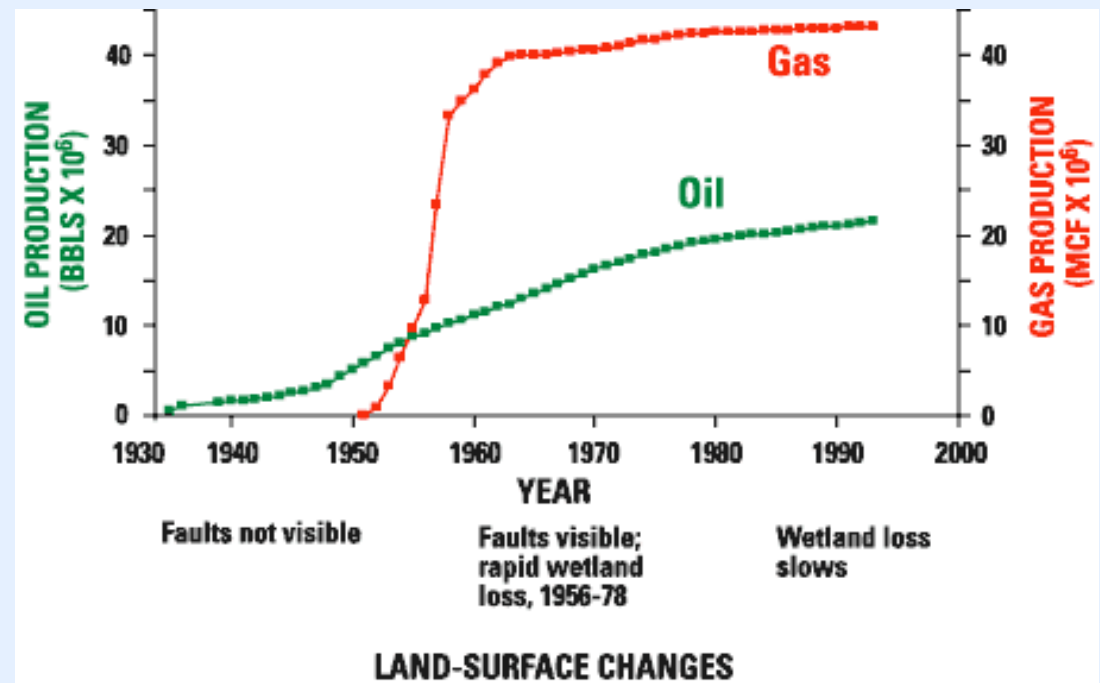
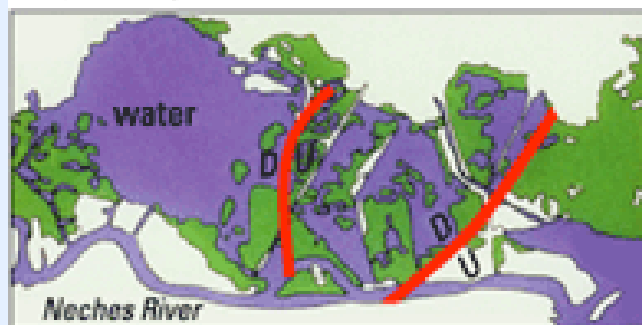
35-90 cm - 75 times higher than  
Natural land subsidence

Cumulative production

1956



1978



White Morton, USGS 1997

# Ekofisk, Norway

Conoco-Phillips 35%  
Eni 12%

180 offshore  
70 meters deep

42 cm a year (1986)

In 20 years: 5 meters

Total estimate ~ 9 meters



# Ekofisk, Norway

Consequences, costs:

Wells, rigs and pipelines deformed

Artificially raise  
platform by 10 meters

Water reinjection

1996: 1 billion dollars

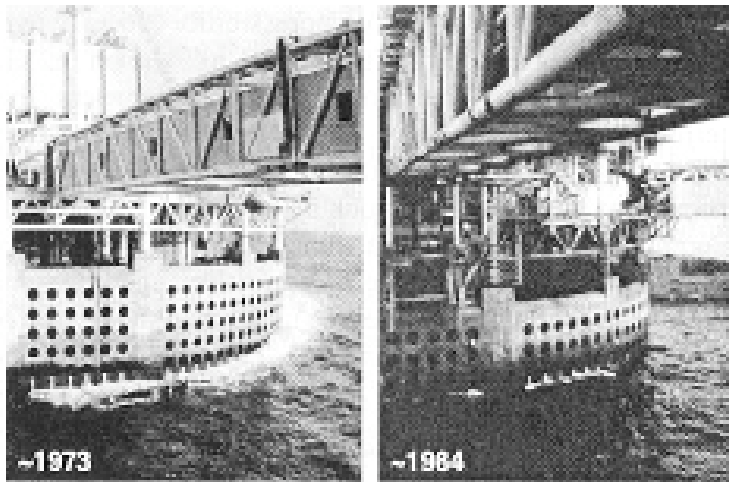
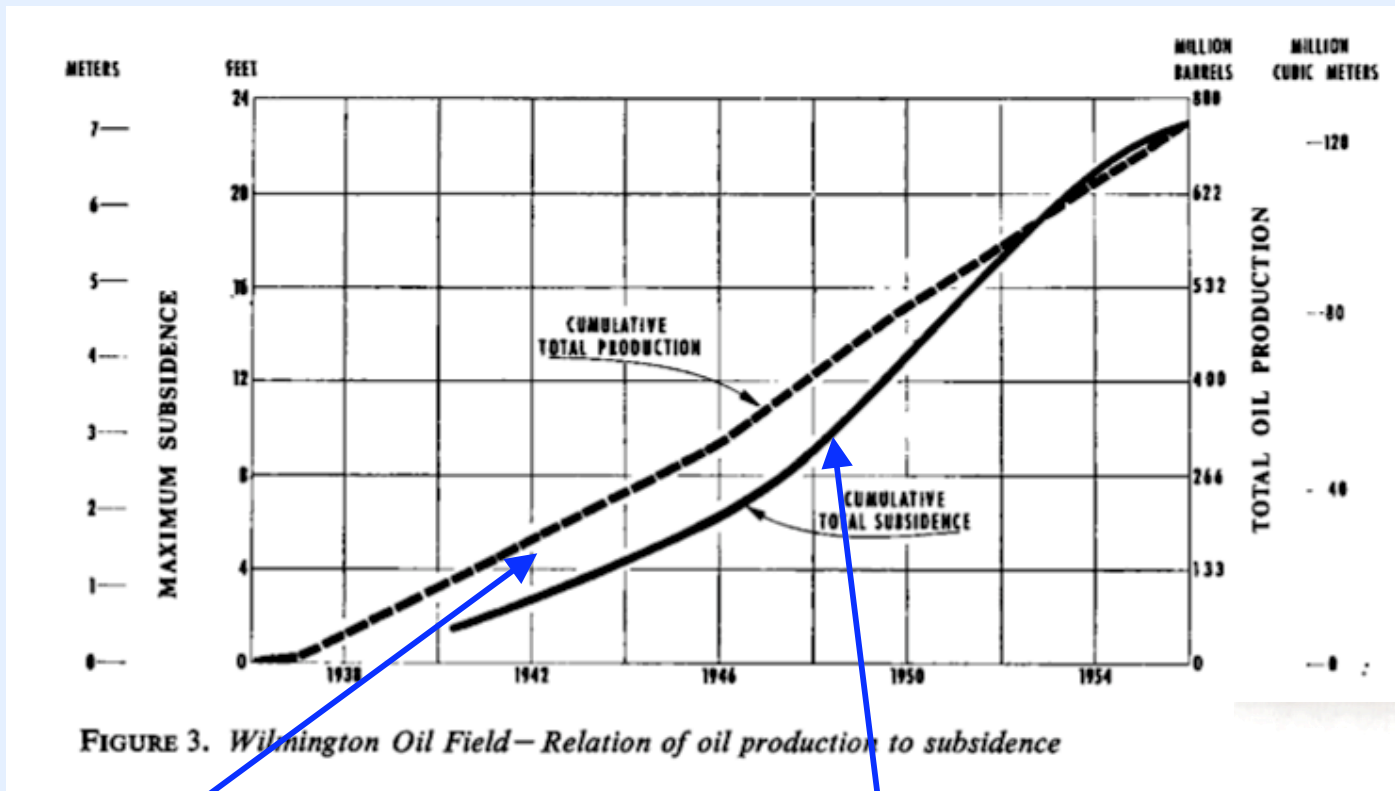


Fig. 5. Photographs of the 2/4T platform at the Ekofisk field. Subsidence was confirmed by comparison of the number of holes visible in the exterior protective wall.

THEY COULD ONLY SLOW IT DOWN AND NOT STOP IT

# Wilmington, Long Beach



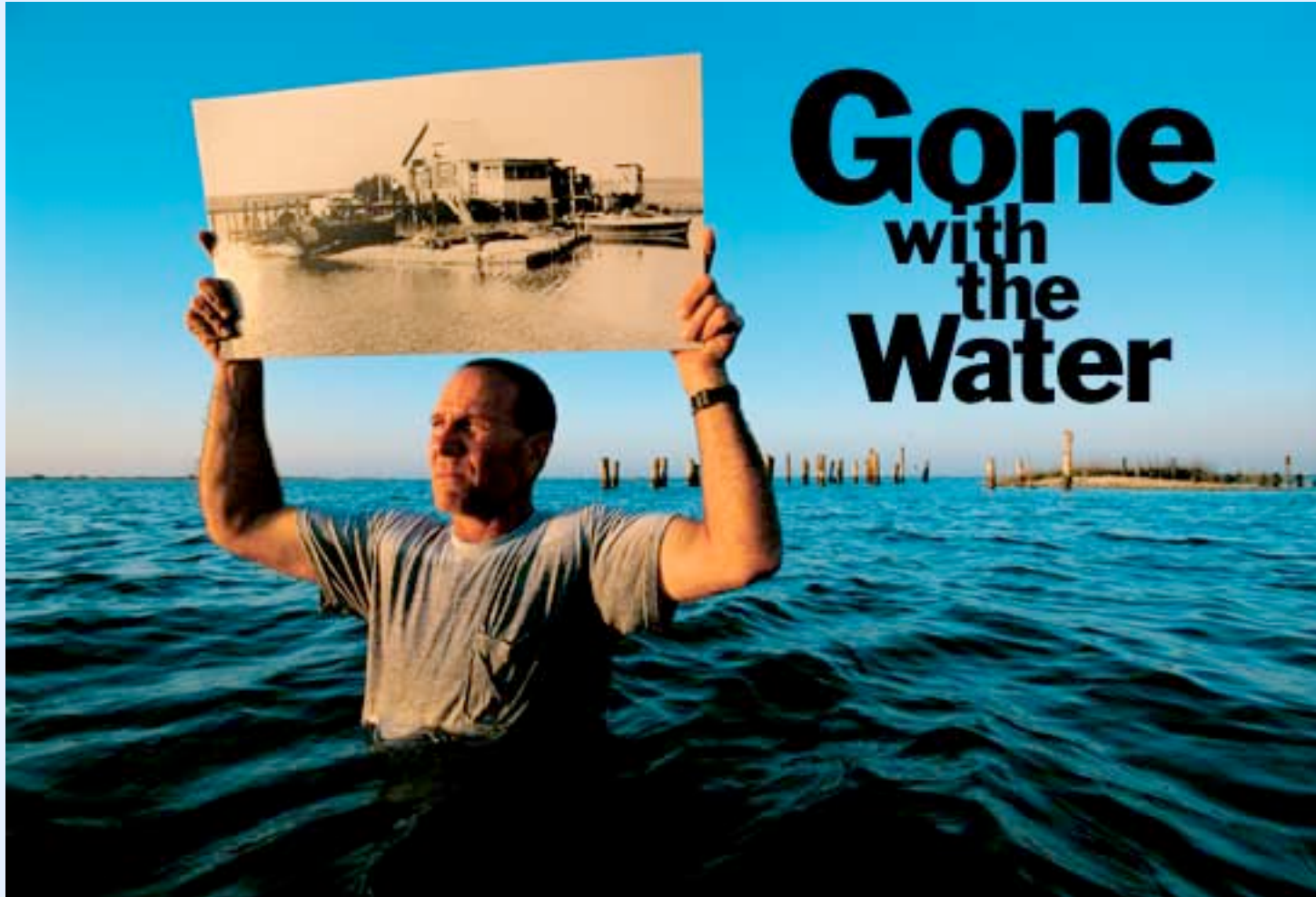
Petroleum extracted

Subsidence

9 meters - deformed rigs  
water reinjected  
30 million dollars (1958)



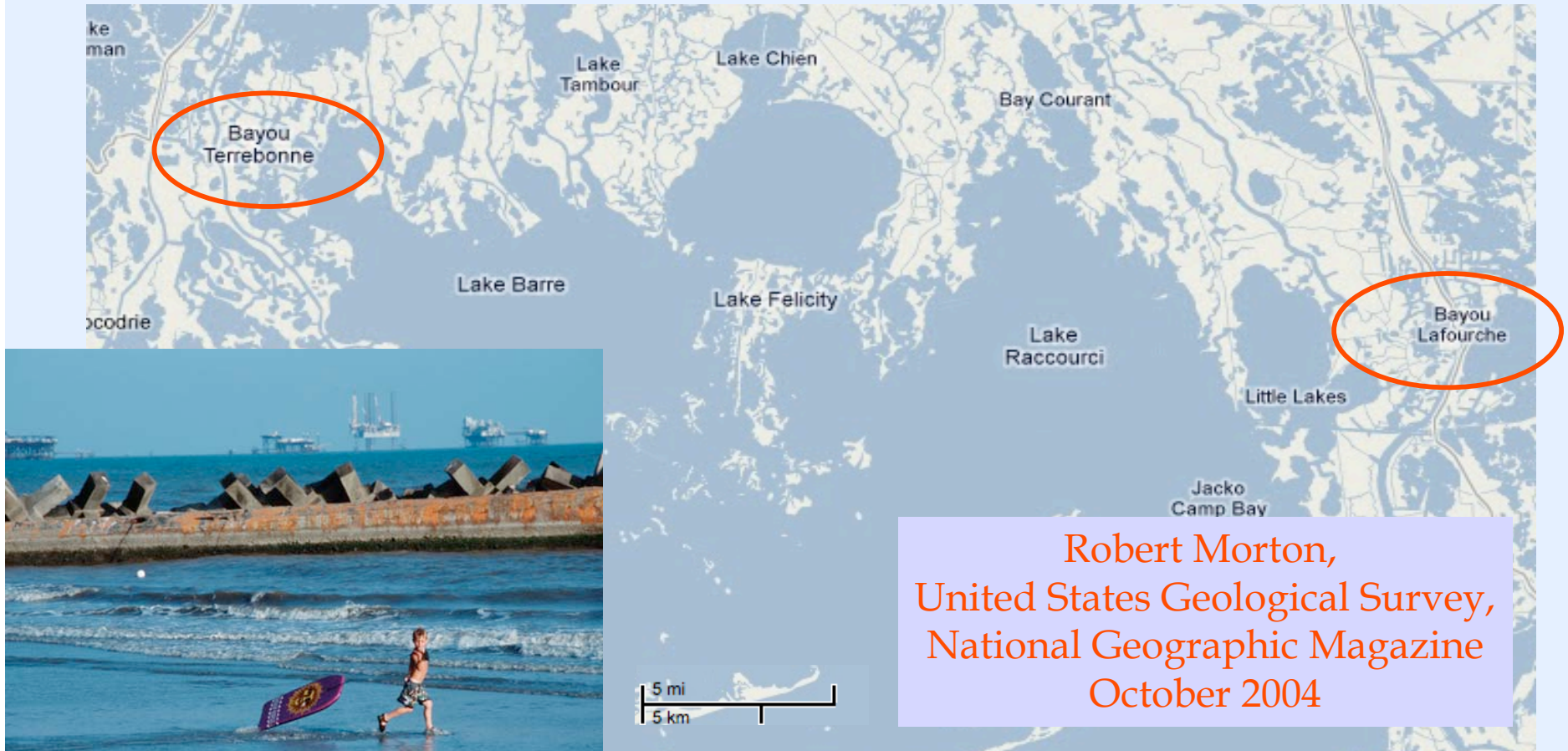
# Louisiana



5,000 square km lost since 1930  
14 billion dollars for “partial” fixup - tax payer money

For decades geologists believed that the petroleum deposits were too deep and the geology of the coast too complex for drilling to have any impact on the surface.

“What I can tell you is that much of the loss between Bayou Lafourche and Bayou Terrebonne was caused by induced subsidence from oil and gas withdrawal”



Robert Morton,  
United States Geological Survey,  
National Geographic Magazine  
October 2004



## Campo a gas di Angela-Angelina

STUDIO PREVISIONALE DELLA SUBSIDENZA INDOTTA DALLA COLTIVAZIONE DEL CAMPO A GAS DI ANGELA-ANGELINA CON L'UTILIZZO DI UN MODELLO 3D NON LINEARE?

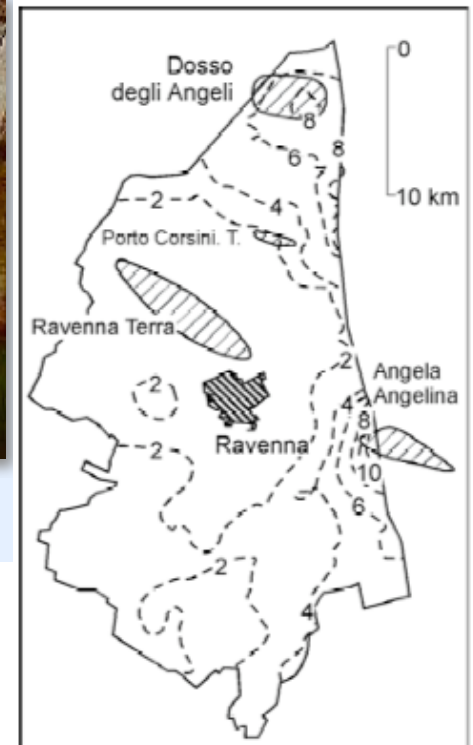


Fig. 12 – Subsidence rate contour lines (mm/y, dashed) and gas reservoirs in the Ravenna area. (Redrawn from BERTONI, 2003).

MED-ingegneria, ENI 1999

La subsidenza calcolata è stata confrontata con i valori misurati dalle livellazioni di alta precisione fatte eseguire dal Comune di Ravenna depurati delle componenti di subsidenza naturale e di compattazione superficiale (indotta dallo sfruttamento di acque artesiane) stimata dalle misure di estensimetri a cavo installati nell'area da alcuni anni. Il confronto indica un buon accordo tra abbassamento misurato e calcolato. L'applicazione modellistica è stata quindi eseguita in fase previsiva, calcolando la subsidenza al 2050. I risultati ottenuti hanno evidenziato come al proseguire della produzione aumenti l'importanza della subsidenza legata alla compattazione del waterdrive rispetto a quella del giacimento. L'incidenza di quest'ultima scende dal 57% del 1998 al 30% nel 2026, anno in cui termina la produzione, al 27% nel 2050.

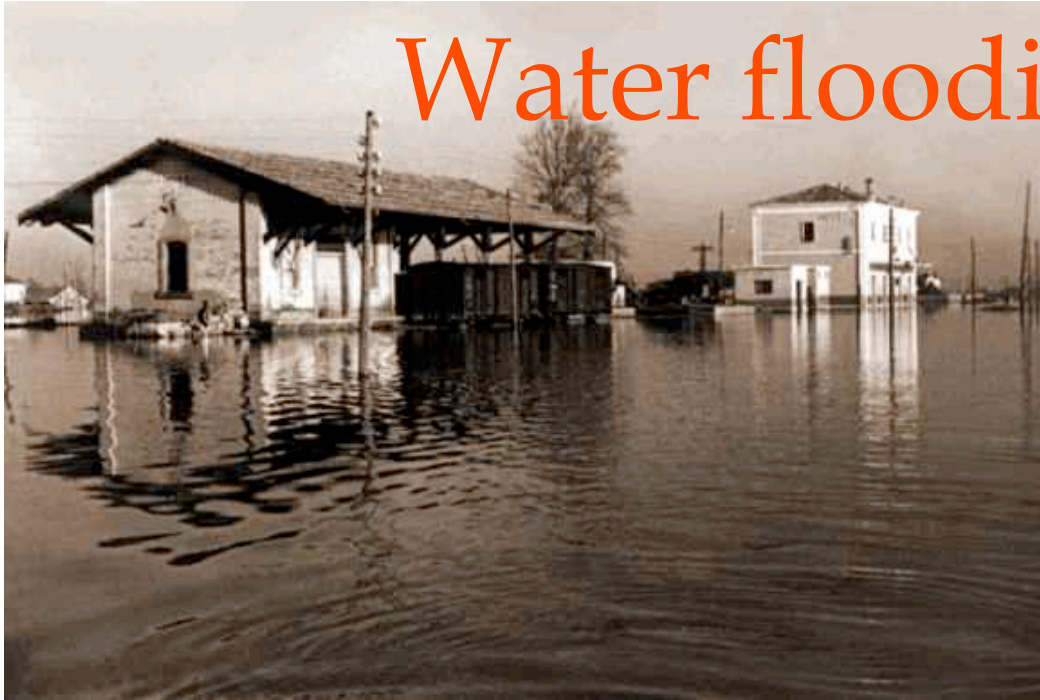
In the last decades, Ravenna and its surroundings have been affected by man-induced subsidence  
of about 50 times the natural rate  
mainly due to  
water pumping for civic usage and then to  
the extraction of methane.

The shoreline erosion will continue to follow  
the same trend, resulting in a 50-70 meter  
retreat of the beach.

In some zones, Lido Adriano to Punta Marina,  
the beach erosion will be even greater (100 m).  
Most coastal areas will probably have to be abandoned  
to the sea

Bertoni et al. The subsidence of Ravenna 2005

# Water flooding 1960-s



## 5. INDUCED SEISMICITY

# Russia, 1960:

## Seismicity in the Oil Field

In some regions, hydrocarbon production can induce seismic activity. To help understand how production affects seismicity, a recording network was installed in a producing field in Russia. In a cooperative project between Schlumberger and the Institute of Dynamics of Geospheres at the Russian Academy of Sciences, scientists are analyzing the recorded data to help forecast seismic events, understand reservoir properties and monitor water injection.



▲ Location of the Remashkino field, Russia.



▲ Location of the Gazli field, Uzbekistan.

Gazli, Uzbekistan

NON SEISMIC AREA

DRILLING

6.0, 6.3, 7.0 Richter

Romashkino, Russia 4.0 Richter

Kuwait, 4.7 Richter

**Vitaly V. Adushkin**  
**Vladimir N. Rodionov**  
**Sergey Turuntaev**  
*Institute of Dynamics of Geospheres,  
Russian Academy of Sciences  
Moscow, Russia*

**Alexander E. Yudin**  
*Ministry of Fuel and Energy of the  
Russian Federation  
Moscow, Russia*

Much of this article originally appeared in the Schlumberger  
Russian version of the *Oilfield Review*; *Neftegazovoye*

**The 1993 M4.7 Kuwait earthquake: Induced by the burning of  
the oil fields**

**FIRYAL BOU-RABEE\* AND AMOS NUR\*\***

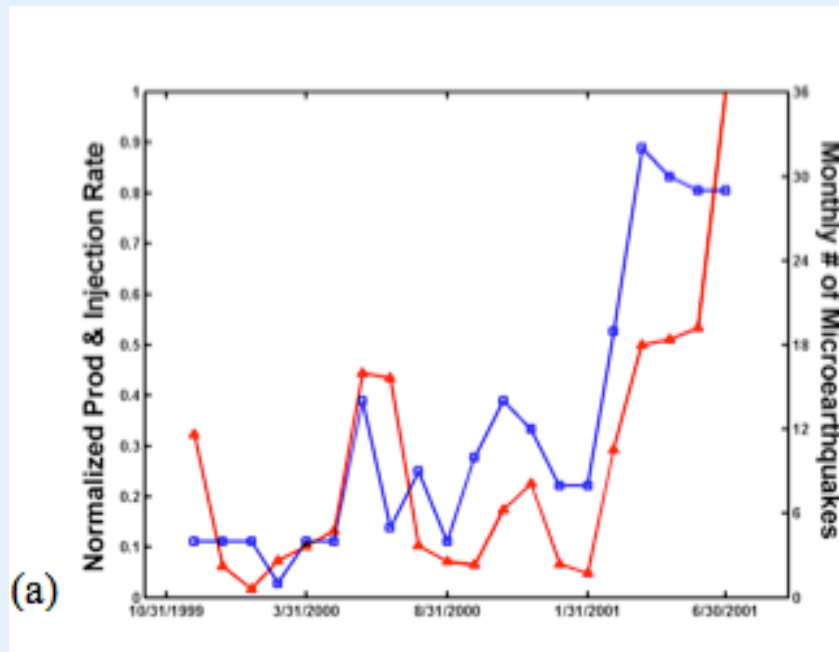
*\* Department of Earth and Environmental Sciences, Kuwait University, Kuwait*

*\*\* Department of Geophysics, Stanford University, USA.*

# Oman, 1990:

## Characterization of Induced Seismicity in a Petroleum Reservoir: A Case Study

Edmond Sze, M. Nafi Toksöz, and Daniel R. Burns  
Earth Resources Laboratory  
Dept. of Earth, Atmospheric and Planetary Sciences  
Massachusetts Institute of Technology  
Cambridge, MA 02139



Rosso: hydrocarbon production  
Blu: micro-earthquakes

Oman: 400 micro-earthquakes in 2 years 1999-2001

# France, 1990:

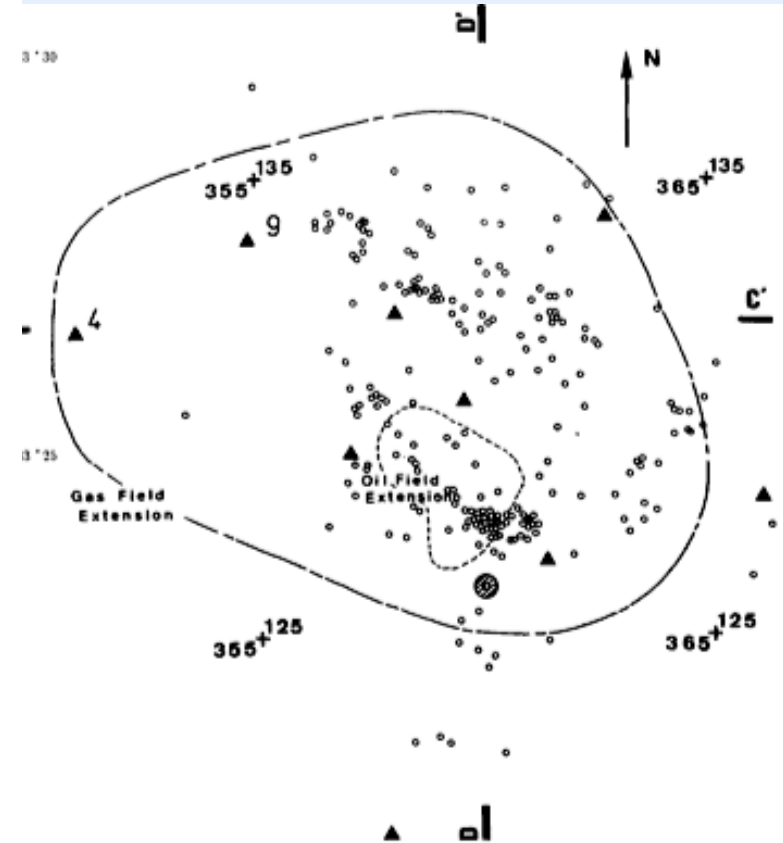
Bulletin of the Seismological Society of America, Vol. 80, No. 2, pp. 450-473, April 1990

## TEN YEARS OF SEISMIC MONITORING OVER A GAS FIELD

BY J. R. GRASSO AND G. WITTLINGER

### ABSTRACT

Ten years of seismic recording allows us to locate more than 800 tremors with magnitudes ranging from 1.0 to 4.2, in a small (10 by 10 by 5 km) volume near a major gas field (Lacq, France). The seismic activity began 10 yr after gas extraction began. Nearly all of the epicenters are located within the lateral extent of the gas field. The only perturbation of the stress or strain fields, which has the same spatial and temporal scale as the seismicity, is the 500-bar drop in gas pressure due to 20 yr of gas exploitation, demonstrating that these events are induced. The network, established to monitor this activity, consists of eight telemetered stations including a well-bottom geophone located at 3200 m depth. Using three-dimensional relocation techniques, we computed new hypocenter positions for more than 280 events. These better-located hypocenters form a diffuse zone that mimics the local dome structure. Taking the regional tectonic stresses into account, we suggest that these ruptures may be the result of unfolding of the dome structure.



Francia: 800 micro-earthquakes in 10 years 1980-1990  
Up to 4.2 Richter

# Texas, 2009:

## Earthquakes in Cleburne? Some North Texans suspect drilling behind recent quakes

BY JOHN-LAURENT TRONCHE

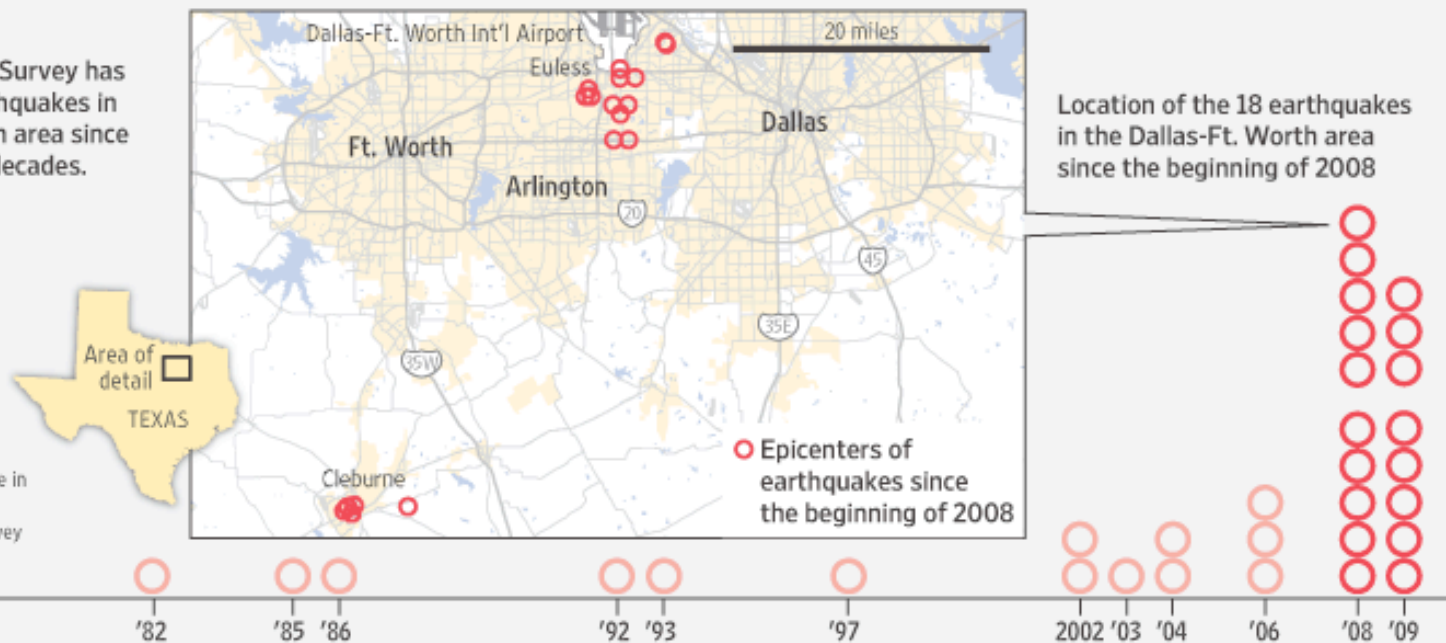
June 10, 2009

2/3 Richter

### Shaken Up

The U.S. Geological Survey has detected more earthquakes in the Dallas-Ft. Worth area since 2008 than in prior decades.

Note: Earthquakes here range in magnitude from 1.7 to 3.5.  
Source: U.S. Geological Survey



## Oil Drilling Likely Caused Texas Earthquake

Posted by [feww](#) on May 17, 2009

## Magnitude 3.3 Quake Strikes Northern Texas

**Texas quake likely caused by oil and natural gas drilling**

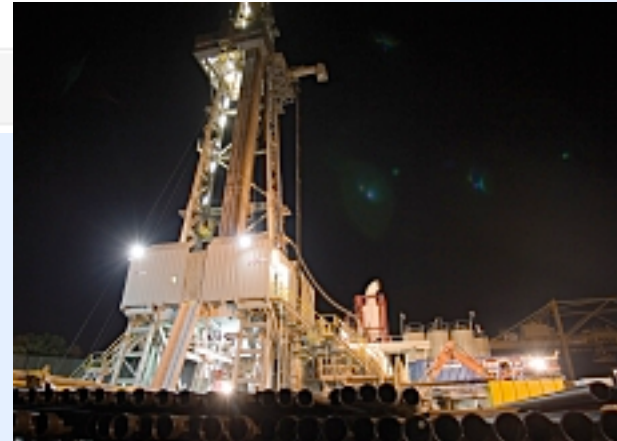
# Basel, 2006:

## Drilling caused Swiss earthquakes

Associated Press

Last updated 11:59 16/12/2009

3.4 Richter - preliminary rig  
For geothermal purposes



From The Times

December 17, 2009

## Head of Geopower Basel faces jail for causing earthquakes

**TIMES**ONLINE

## 5. THE TAR SANDS OF CANADA

# Canada Tar Sands



Canada's tar sands are layers of sticky,  
tarlike bitumen mixed with sand, clay, and water.

Around a hundred feet of soil must be stripped off to reach deposits.

At the extraction plant, bitumen is separated from sand in a hot-water wash. The bitumen is diluted with less dense oil and then sent to an upgrading facility that converts it to synthetic crude oil.

Sand, water, and bitumen residues are finally piped to a tailings pond, where the water is extracted, cleaned, and reused in the mines.

About half the oil produced heads south:  
The U.S. is Canada's biggest oil customer,  
importing more from its northern neighbor than from any other nation.

# Canada Tar Sands



# Canada Tar Sands



# Canada Tar Sands



# Canada Tar Sands



# Canada Tar Sands



# Environmental and social issues

Fish are often covered in unusual red spots.  
Some believe toxic chemicals,  
such as those released during bitumen production,  
are leaching into Alberta's rivers and lakes.

*Pushed in faces, bulging eyes, humped back,  
crooked tails . . . never used to see that.  
Great big lumps on them . . . you poke that it sprays water*

High prices of real estate, high living costs, homelessness  
Unemployment, high numbers of lonely men - alcoholism,  
traffic congestions



Clusters of rare cancers - close to mining operations  
Fort Chipewyan  
High incidence - oil related?  
Water no longer drinkable from Lake Athabaska

# David Schlinder, U of Alberta

The propaganda put out by industry and the Alberta government is that this huge industry is not polluting the river at all. It's absolute nonsense - and, of course, that's the reason we designed our new study.

...arsenic, mercury, copper, chromium, nickel, selenium, beryllium, lead, cadmium, silver, zinc, antimony and thallium...

And in nearly every site downstream of tar-sands extraction and processing, concentrations of these hazardous materials were higher - sometimes dramatically so - than in waters upstream of tar-sands development.

Aug 30 2010

## 6. AT RISK AREAS

# North pole



US, Canada, Russia, Norway, Denmark  
Haphazard patchwork of legislation - no current regulations  
Clean up is difficult in frozen areas - Pollution risks  
Lisa Speer, NDRC

# Bush - era leases

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- [Business](#)

## Bush-era energy drilling leases in Utah canceled

### Interior Department to review whether to open those federal lands



Doug Pensinger / Getty Images file

Leases to drill near two national parks in Utah, including Canyonlands, part of which is seen here, are being canceled.

**Video**

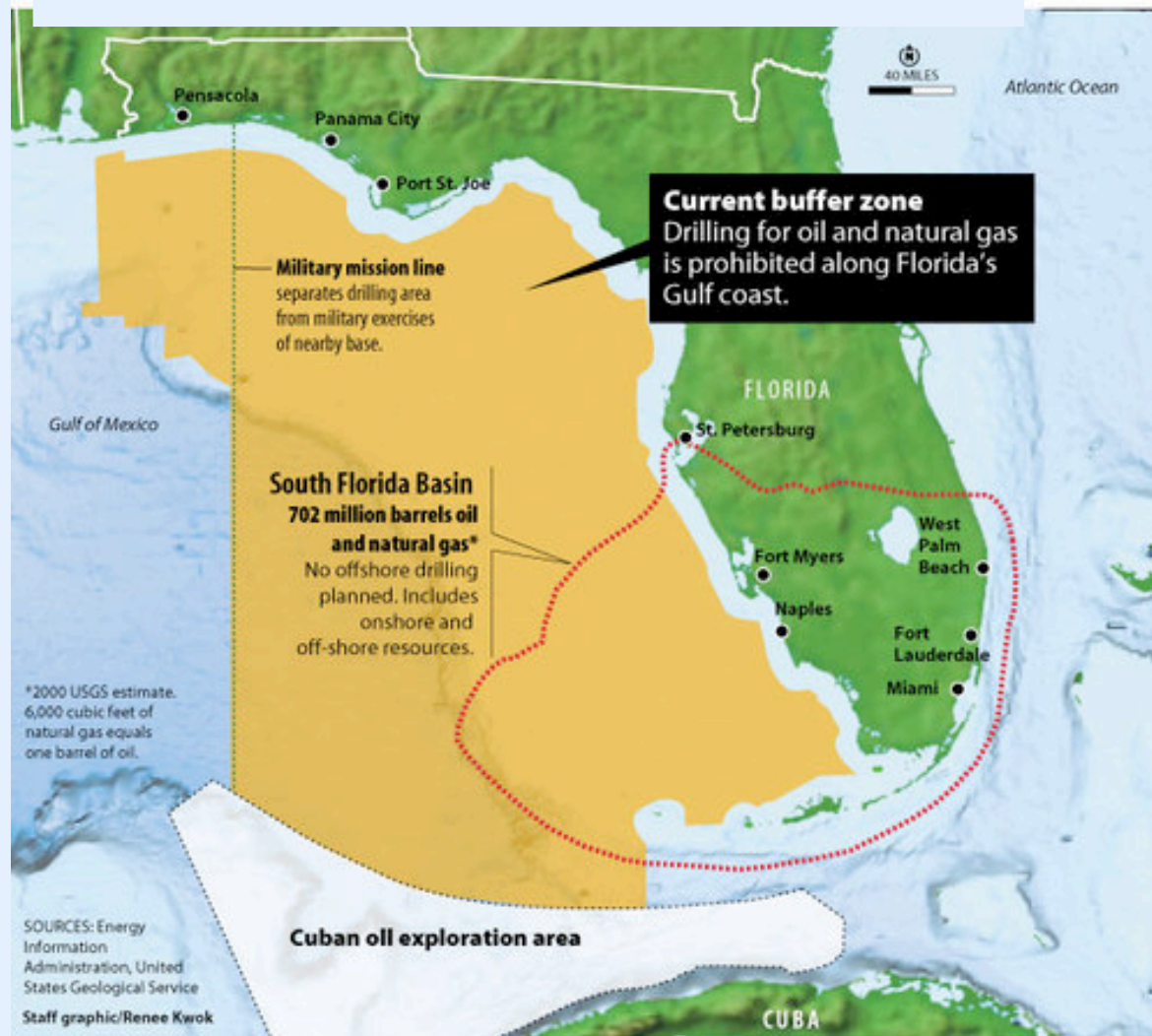
**Launch**

**Redford on Utah drilling**

Dec. 17: Actor Robert Redford discusses the Bush administration's auction of drilling rights near national parks in Utah.

MSNBC

# Florida



# Lake Michigan

## Michigan drilling ban legislation moves through committee today in state House



Legislation calling for a [constitutional ban on drilling](#) in Michigan's Great Lakes took its first steps toward becoming law today.

State Rep. **Rebekah Warren**, D-Ann Arbor, is calling for permanent measures to protect the state's waters from a tragic oil spill disaster like the one caused by BP that is devastating the coastline of the Gulf of Mexico.

Warren, chairwoman of the House [Great Lakes and Environment Committee](#), passed a series of plans through her committee today that would let Michigan voters decide in November on a permanent ban on drilling in the Great Lakes. The plans also urge Canada and other Great Lakes states to do the same.

"Today we took some very important steps toward permanently banning drilling in the Great Lakes," Warren said. "I simply cannot picture what a catastrophe the likes of which we're seeing in the Gulf of Mexico would look like on Michigan's shorelines, nor do I want to. With a permanent ban we can make sure that day never comes."

While drilling in the Great Lakes is against state law, Warren said the state Legislature and governor currently could change that at anytime. The plans passed by the House Great Lakes and Environment Committee today would:

- Give Michigan voters the right to make the ban permanent by making it part of the state constitution. If the Legislature passes the plan, the measure will appear on the November 2010 ballot.
- Urge all of the Great Lakes states and Canada to adopt a Great Lakes drilling ban.
- Recommend adding a ban on drilling in the Great Lakes to the Great Lakes Water Quality Agreement between the United States and Canada.

Michigan would be the first Great Lakes state to enact a permanent ban on drilling. Under current law, companies caught drilling without a permit face fines of up to \$1,000 per day. Those responsible for a spill face fines of up to \$25,000 per day and are liable for up to \$75 million in damages and are accountable for cleanup.



Rebekah Warren

# The Delaware river watershed



# Yasuni, Ecuador



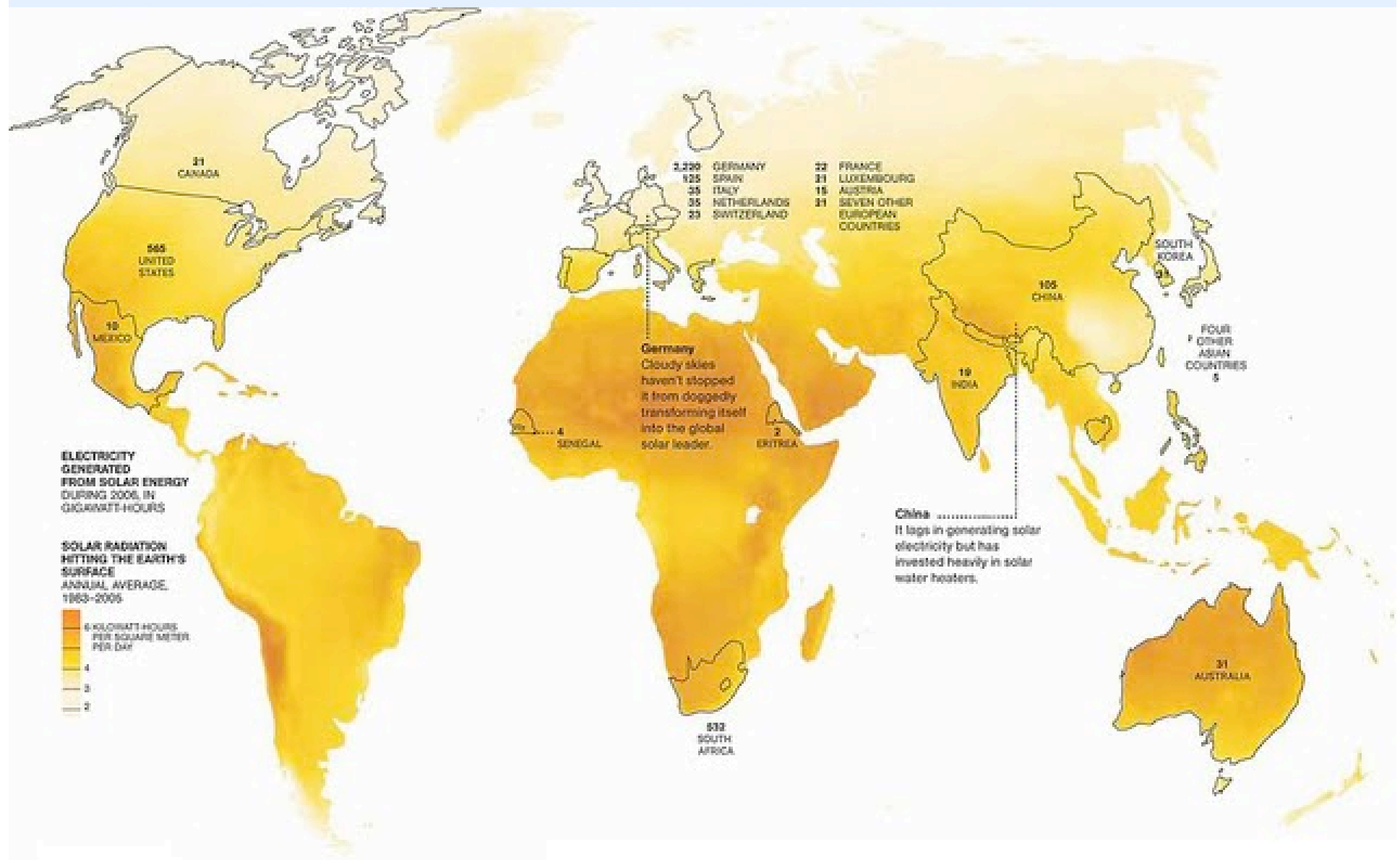
# 3 August 2010



Ecuador's government announced today it has reached a deal with the United Nations Development Program under which donor countries will compensate Quito for leaving oil reserves untouched in a large primary rainforest filled national park. Yasuni National Park – covering some 9,820 km<sup>2</sup>, or about the size of Massachusetts – is thought to be one of Earth's most biodiversity rich sites and is also home to several nomadic Indian tribes.

## 7. WHAT TO DO?

# Germany -USA: 2,200 - 565



But most of all



CONSERVE  
&  
THINK

<http://www.ecomall.com/greenshopping/20things.htm>

# Thank you:

Prof. Thomas Chou, UCLA (USA)

Prof. Kaye Kilburn, USC (USA)

Dr. Bob Morton (USGS)

Prof. Chad Topaz, Macalester Univ. (USA)

Prof. Tee Guidotti, Univ. of Alberta (Canada)

Prof. Igor Burstyn, Univ. of Alberta (Canada)

Dr. Valeria Tano, EPO (Germany)

Fabrizia Arduini

NSF grant 0719462

## 8. MY STORY

# The power of education:

stopping big oil in rural Italy,  
one powerpoint presentation at a time



Maria R. D'Orsogna,  
California State University at Northridge, Los Angeles, CA (USA)

For the ignorance of the public  
is the real capital of monopoly

H. D. Lloyd, 1894

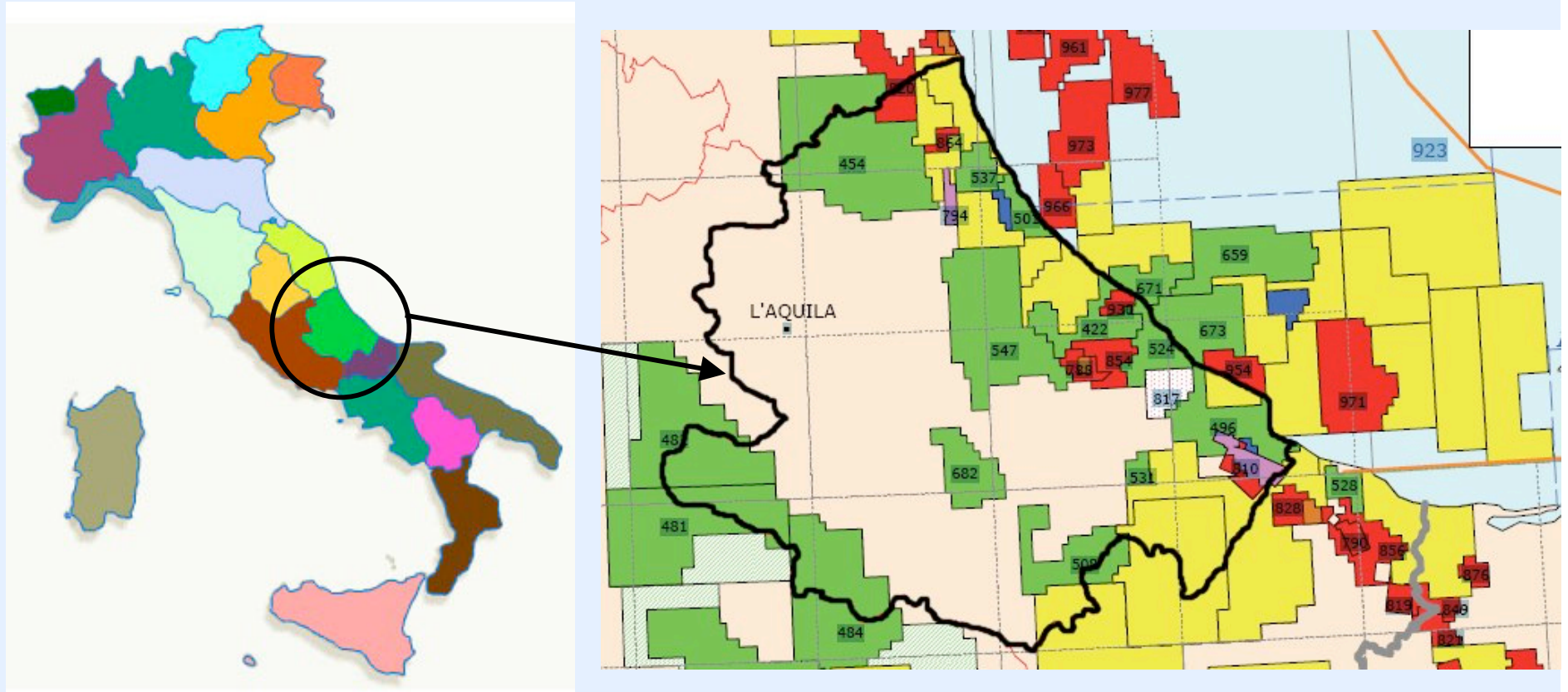
Communities that live where oil is found - from Ecuador to Nigeria to Iraq  
experience the tyranny of daily human rights abuses, violence and war.

The tyranny of environmental pollution, public health risks, and climate  
destruction is created at every stage of oil use, from exploration to production  
From transport to refining, from consumption to disposal.

And the political tyranny exercised by the masters of the oil industry corrupts  
democracy and destroys our ability to choose how much we will sacrifice in  
oil's name.

Antonia Juhasz,  
The tyranny of oil

# Oil in Abruzzo:

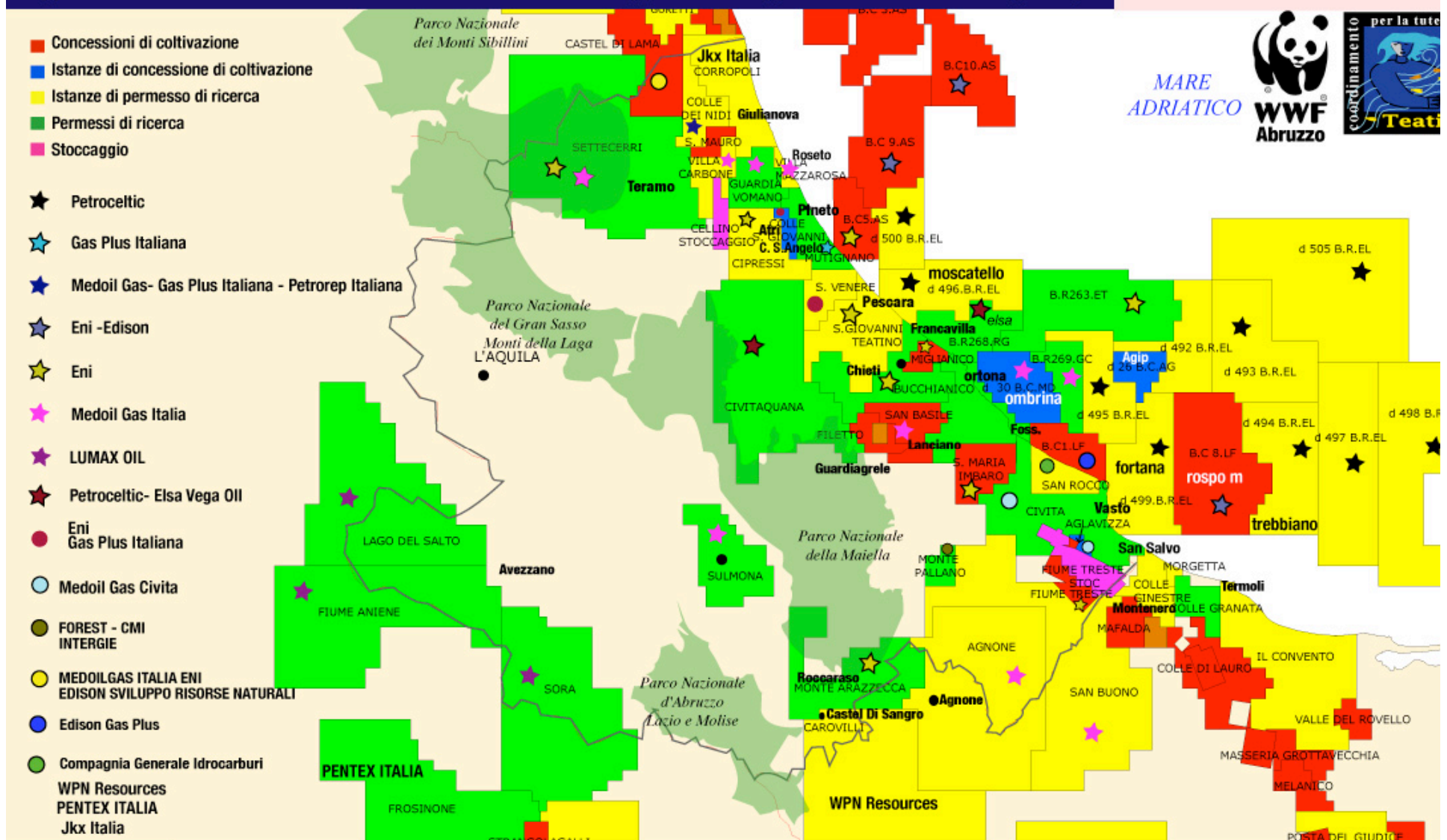


Green: oil permits submitted,  
Yellow: oil permits pending, Red: oil permits approved

Abruzzo, today:



Mapa istanze e concessioni idrocarburi al 12/2008 mediante sovrapposizione mappa Titolo UNMIG con Google Maps



# Abruzzo, tomorrow?

# Semi-secret planning, ENI:

2001-2007

On and offshore wells, 1 refinery, pipelines

Low quality oil, highly polluting

Oil refinery:

1.5 tons of pollutants a day  
(1 ton CO<sub>2</sub> per day)

Oil rigs 2 miles from shore

Corruption, little education



# Oil refinery site, today



# What can I do?

15 October 2007: *'there is nothing you can do, Maria'*

Research, emails to newspapers, catholic church, local mayors

Environmental law very weak  
legal limits for pollutants  
**one thousand times higher**  
than US clean air act standards

No limitation for oil rigs in water

Documentation in Italian,  
easy comprehension



# Educating the people:



Piazzas, city halls, schools, priests, politicians, skype  
cinemas, TV, newspapers, magazines, documentaries, dvd

Threats

Debate with the oil company ENI

*"You are too young to understand how the world really works"*

**LA STAMPA** Data 09-10-2009  
Pagina 22/23  
Foglio 1 / 2

# Il teologo del Papa in guerra con l'Eni

## La svolta ecologista di monsignor Forte

**GIACOMO GALEAZZI  
GIUSEPPE SALVAGGIULO  
PESCARA**

Dalle «Meditazioni teologiche sul sacerdozio ministeriale» alla lotta contro il petrolio. Dalla «Trinità per ateisti» alle disariche abusive. Dalle

blici ringraziamenti alla Chiesa «che ha fatto aprire gli occhi a tutti».

Quando Forte si è schierato pubblicamente contro i progetti petroliferi, gli attivisti delle associazioni ambientaliste hanno fatto un balzo nella gioia. E da ora di entusiasmo

genere è una gravissima minaccia al lavoro dei campi, alla salute, al turismo. Nella provincia di Chieti abbiamo 34 cantine sociali, siamo al quarto posto in Italia per esportazione di vino. Se tutto ciò viene danneggiato, si mette in dubbio il futuro

The pope's theologian

**BBC** Low graphics Help Search

## NEWS

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News Front Page

Page last updated at 09:11 GMT, Friday, 17 July 2009 10:11 UK

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### Wine, olives and crude oil



Grapes grown in the region make Italy's famous Montepulciano d'Abruzzo wine

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**no**



# ALL'ABRUZZO PETROLIZZATO

<http://nopetrolio.blogspot.com/>

pozzi petroliferi raffinerie gasdotti  
oleodotti petroliere piattaforme



**emergenzaambienteabruzzo**  
rete di associazioni  
<http://blog.libero.it/emergenzaambiente/>



**CONCOMMERIO**  
CHIETI

The Chamber of Commerce

Al Gore's TV

BETA

# current

home tv shows s

news movies music green tech comedy

## Il Futuro dell'Abruzzo

[http://current.com/items/91188760\\_il-futur...](http://current.com/items/91188760_il-futur...)



# One step at a time:

The refinery has not been built. No oil operations have been completed in Abruzzo - at least not yet



Still a long way to go  
Long term moratorium!

In the meantime, one oil rig at a time.

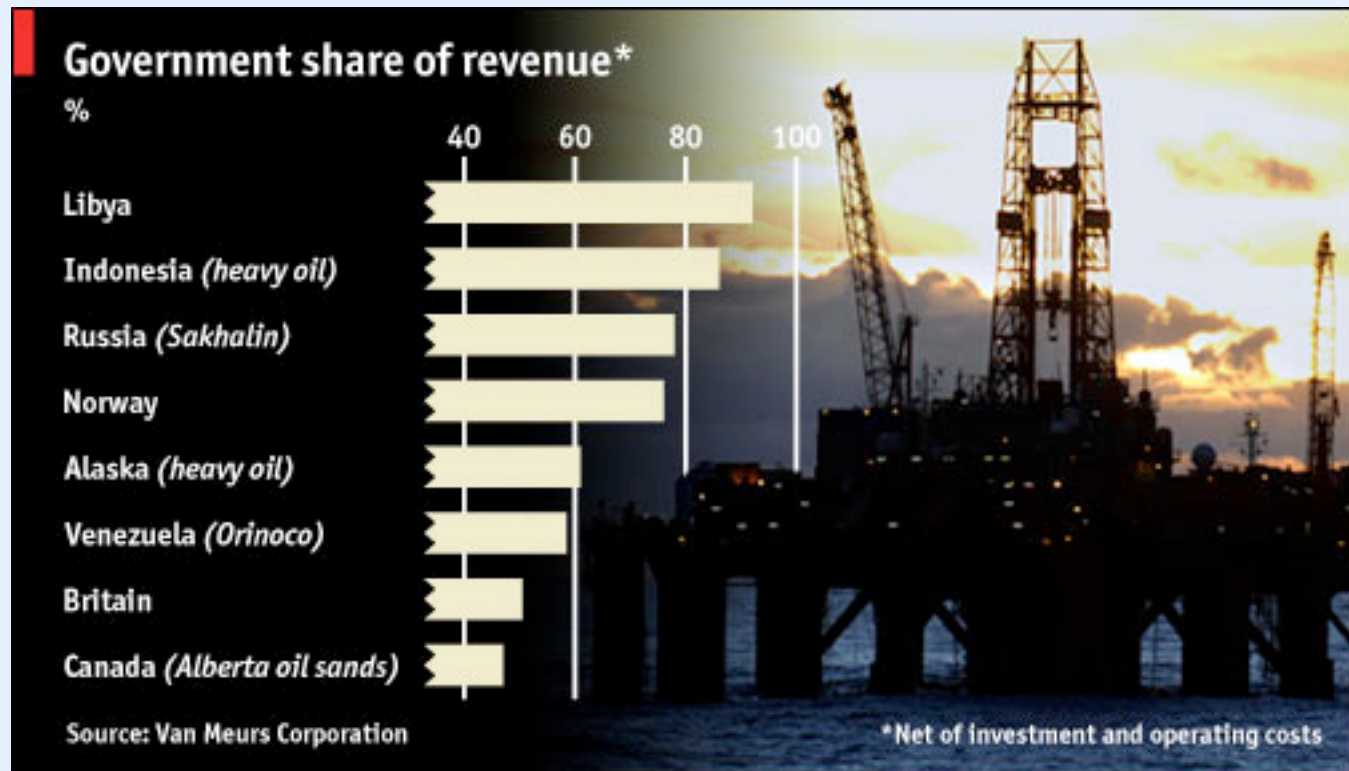
Venice, Milan, Sardinia, Rome, Genova, Potenza, Bologna



*“when you do nothing, you feel overwhelmed and powerless.  
but when you get involved,  
you feel the sense of hope and accomplishment that comes from  
knowing you are working to make things better.”*

[www.savethemontepulciano.blogspot.com](http://www.savethemontepulciano.blogspot.com)  
[www.dorsogna.blogspot.com](http://www.dorsogna.blogspot.com)

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**California bill seeks oil tax to aid colleges**

Nanette Asimov, Chronicle Staff Writer  
Monday, October 12, 2009

California 0%  
Assembly Bill 656 Torico