

43rd U.S. Rock Mechanics Symposium

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Rock Mechanics / Geomechanics from an Energy Perspective

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First, a few words about ARMA

What is ARMA – Professional Association

What is the ARMA Mission –

To be the recognized representation of multi-disciplinary rock mechanics advancements and applications, to serve its Members and the Public.

How does ARMA Accomplish this –

- ARMA will encourage individuals and accept Members who share a common interest in rock mechanics
- ARMA will be the technical leader in rock mechanics via sponsored symposia, publications, workshops, training courses, other means
- ARMA will provide recognition of its Members for individual accomplishments, expertise in rock mechanics, and public benefit
- ARMA will offer advisory expertise to help Government, Academia, Industry, and the Public

Rock Mechanics / Geomechanics from an Energy Perspective

- **Begin by making some comments about “Energy”**
- **Share some perspectives I have from the last energy crisis—
related to rock mechanics / geomechanics**
- **Draw some Conclusions**

What about Energy

World commodity / largest commodity next to currency trading

What are the problems ?

1. Large amount of carbon being put into the atmosphere
2. Energy, just as nearly any business, cycles from excess to scarcity
3. Because some have [current] energy sources and some do not, this leads to a great “shifting of wealth”
4. **Someday we will run out of oil, gas, and coal—firstly, cheap oil**

What can we learn from the last Energy Crisis—1970's

Looked at:

- Oil, Gas, and Coal Production
- Geothermal Energy Recovery
- Energy Storage—gas, oil, and exotic storage concepts
- Hydro-Electric & Pumped Hydro Storage
- Began Coal-Bed Methane Recovery
- Heavy oil Recovery and Enhanced Oil Recovery
- Oil Shale, Methane Hydrates were 'Discovered', Insitu Combustion of Coal

Learned:

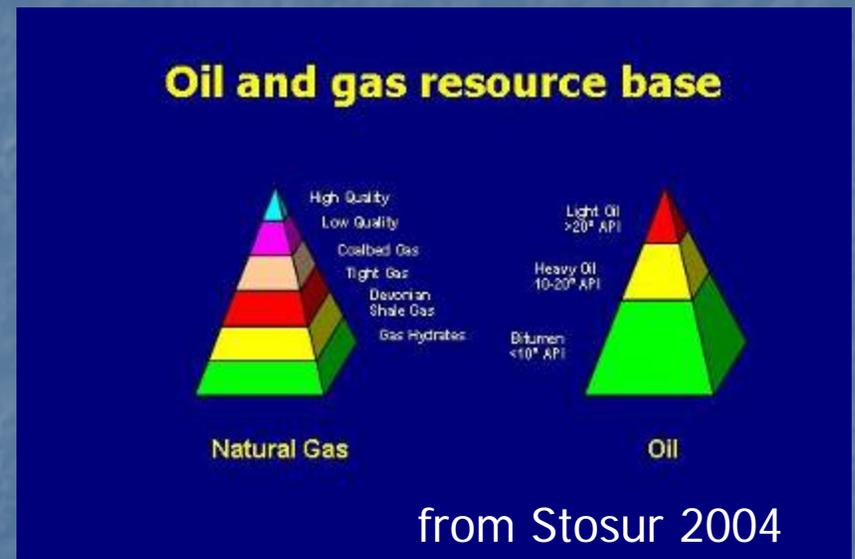
First and foremost—rock mechanics / geomechanics was a key to technology advancements related to energy

**Some perspectives I have from the
last energy crisis—related to rock
mechanics / geomechanics**

Oil & Gas Recovery

1. Drilling

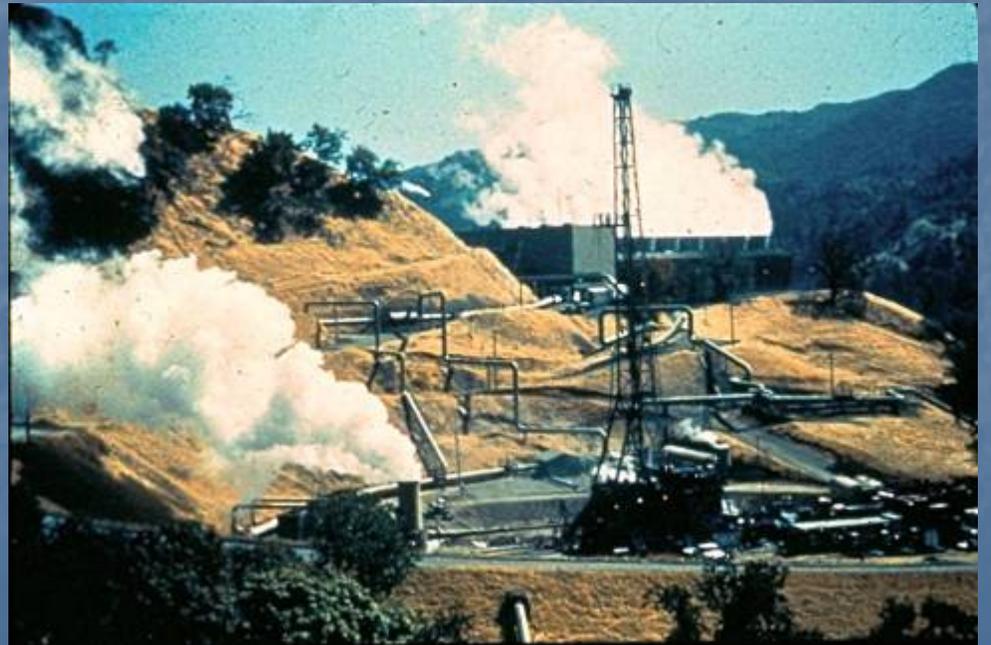
2. Tight Gas Shales



Geothermal Energy Recovery

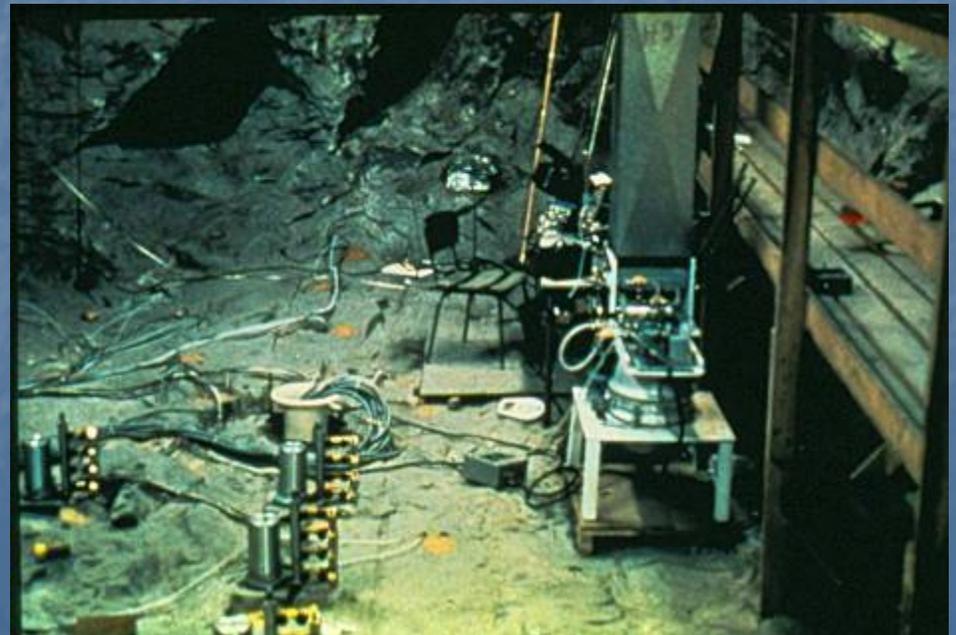
1. Hydrothermal Systems

2. Enhanced Geothermal Systems



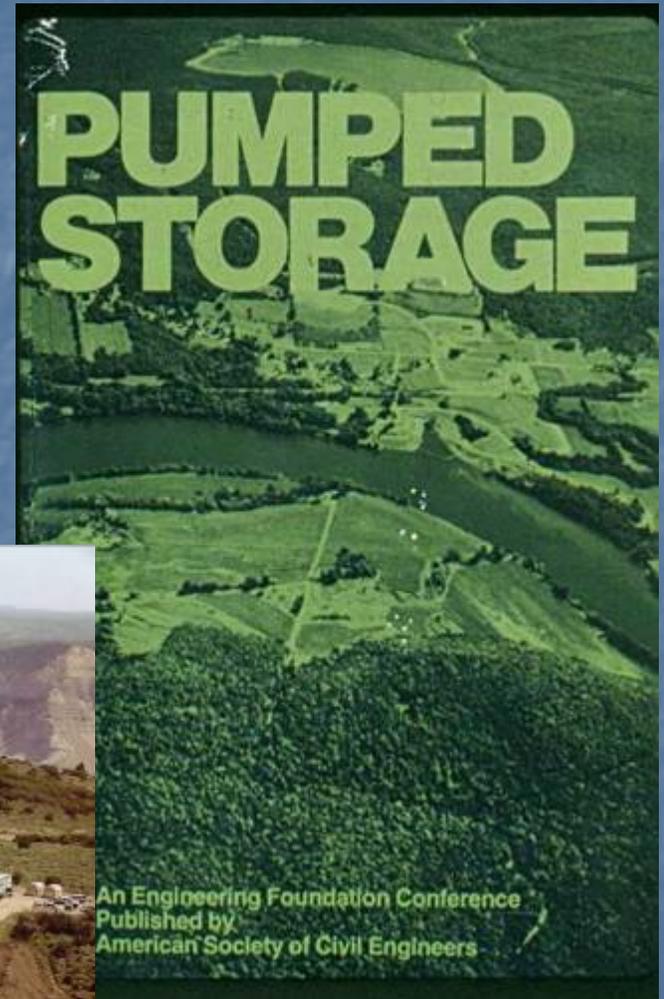
Nuclear Waste Storage

1. Political/Social Problem
2. Geo-Technical Issues are key to a solution



Energy Storage

1. Natural gas storage
2. Compressed air storage / Hot Water Storage / Pumped Hydro Storage



Carbon Sequestering

**1. Large power plant emits
1-3 million tons / year**

(during life of power plant, may be
1-2 billion barrels of CO₂)

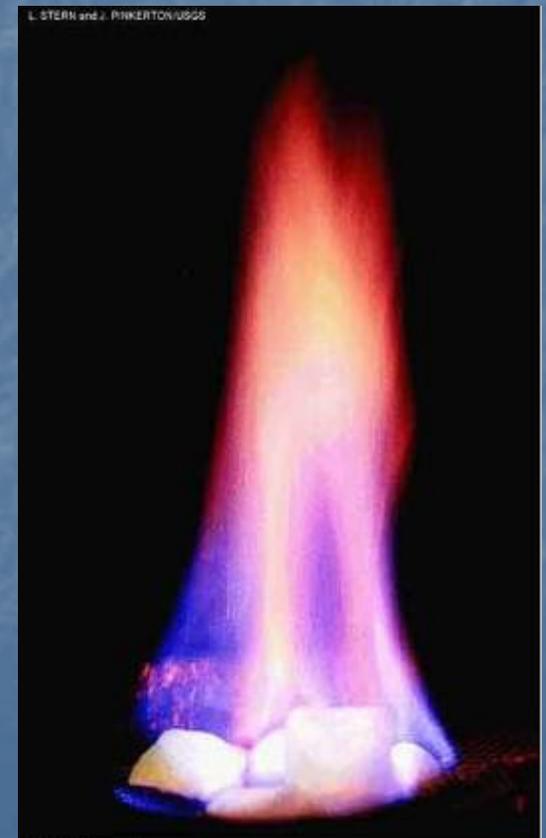
**2. That CO₂ must go
somewhere ??? And, it
must stay fixed**



“Far-Out” Technologies for Energy Recovery

1. Oil Shale

2. Methane Hydrates



Global Observations

What has happened since 1970's Energy Crisis,

- **Oil & Gas – Great Advancements** (downhole motors, PDC bits, horizontal drilling, micro-seismic)
- **Coal Mining – Advancements** (longwall, methane drainage, modeling, roof control, deeper mining)
- **Geothermal – Hydrothermal has been exploited; little progress on dry rock**
- **Nuclear Waste Storage— WIPP Site in operation; commercial storage site ??**
- **Compressed Air & Hot Water Energy Storage—No Applications**
- **Low Head Hydro—Couple of Applications; no significant impact**
- **Oil Shale—Still “close” by some estimates ??**
- **Tar Sands—Heavy Oil of Alberta is being exploited**
- **Deep Water Oil & Gas—much activity; big impact**
- **Coal Bed Methane—big impact; about 8% of US gas supply**
- **Methane Hydrates—being considered at present ??**
- **Insitu Combustion/Conversion of Coal—no applications; being considered**

Conclusions Regarding Rock Mechanics / Geomechanics

- A very 'key player' in energy resource recovery
- Advancements have been made, much the result of computers
- Rock Mechanics/Geomechanics is viewed as a significant business opportunity

Finally ----

Although Rock Mechanics/Geomechanics continues to be key for energy, it is “hard” –mechanics means ‘math and physics’; will “it” rise to the occasion and provide breakthroughs needed ???

Rock Mechanics/Geomechanics offers strong job/career opportunities

‘Forefront’ is getting rock fabric/texture into our analysis

In a Global sense, the World will have to put more \$ into energy recovery—taking away from food, housing, clothing, education, medical care, other things

How priorities work out will be important; of concern is how will education fare ??

and remember,

**perception without facts can be disastrous and
knowledge without wisdom can be dangerous**