



Welcome!

The program will begin soon.
You will not hear audio until we begin.

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Geomechanics for the Energy Transition

Hamed Soroush – CEO at Petrolern LLC
April 27th, 2022

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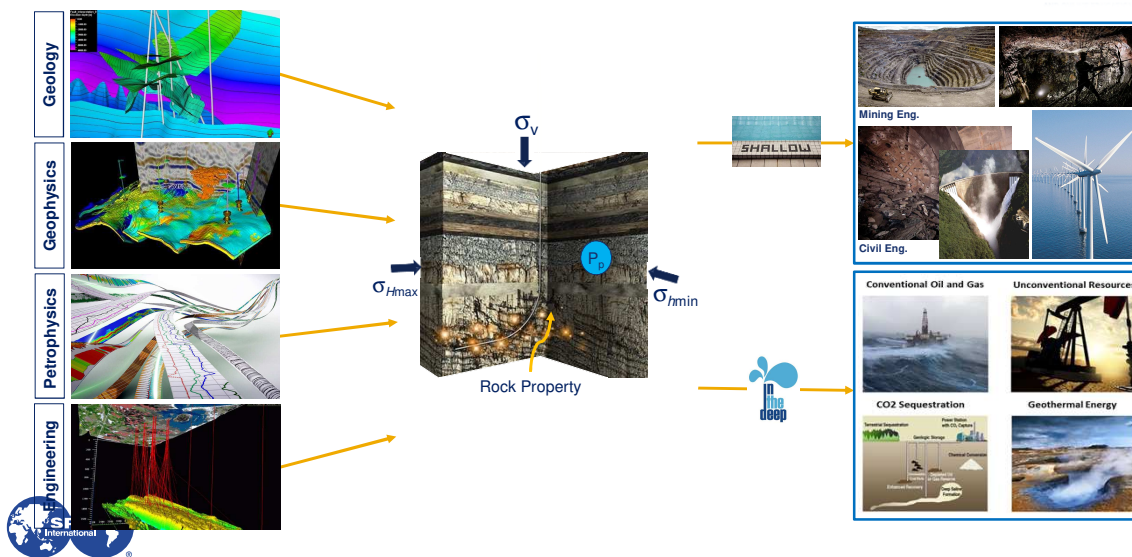
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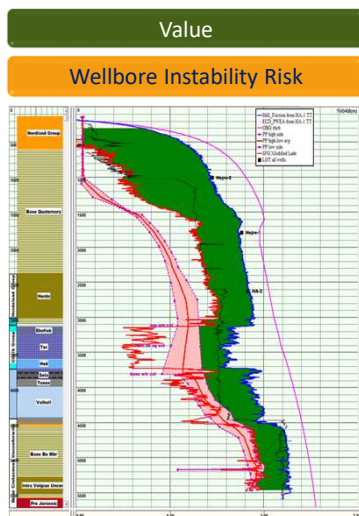
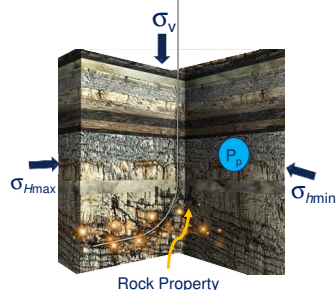
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Geomechanics



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Geomechanics Values to CCS and Geothermal



Geothermal

Important

- NPT less tolerable
- Closed-loop systems require complex drilling
- Drilling in crystallin rock
- Breakout is risk to fracking
- Thermal fracturing

Carbon Storage

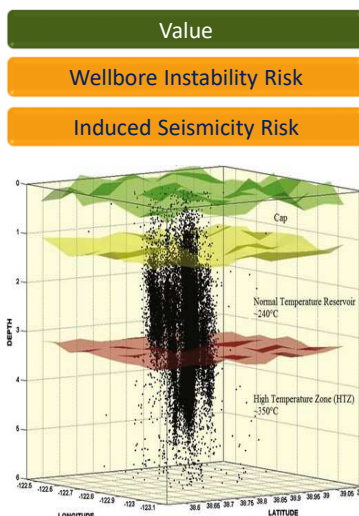
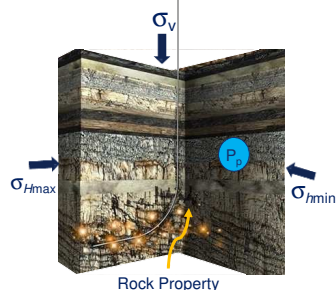
Very Important

- NPT less tolerable
- Breakouts and induced fractures are risk to well integrity and CO₂ leakage
- Cement quality is critical

• Geomechanics plays a major role in converting late-stage stage oil and gas wells to geothermal or CCS wells.

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Geomechanics Values to CCS and Geothermal



Geothermal

Important

Extremely Important

- Risk to human lives/capitals
- Might be a showstopper for EGS
- Risk to well integrity

Carbon Storage

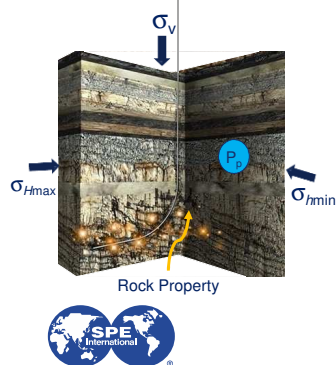
Very Important

Extremely Important

- Risk to human lives/capitals
- Risk to caprock integrity
- Risk to well integrity
- Risk of CO₂ leakage

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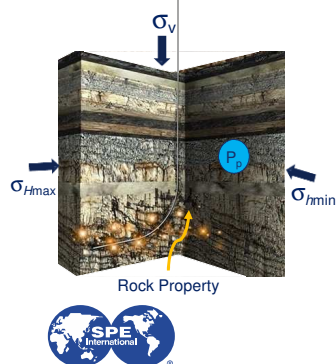
Geomechanics Values to CCS and Geothermal



Value	Geothermal	Carbon Storage
Wellbore Instability Risk	Important	Very Important
Induced Seismicity Risk	Extremely Important	Extremely Important
Reservoir Performance	Very Important	Extremely Important
	- System design - Heat flow performance - Evolution of fractures system - Reactivation of faults and fractures	- Reservoir capacity - Changes in the stress field - CO₂ plume detection - Reactivation of faults and fractures

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Geomechanics Values to CCS and Geothermal



Value	Geothermal	Carbon Storage
Wellbore Instability Risk	Important	Very Important
Induced Seismicity Risk	Extremely Important	Extremely Important
Reservoir Performance	Very Important	Very Important
Caprock Integrity Risk	Important	Extremely Important
	- Fracturing into caprock in EGS - Aquifers contamination by injected fluid in doublets - Reactivation of faults and fractures in caprock - Optimization of fracturing design or injection pressure	- CO₂ leakage to surface - Aquifers contamination by CO₂ - Reactivation of faults and fractures in caprock - Optimization of injection volume/rate

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Future Trends in Geomechanics

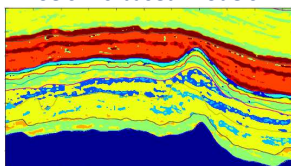


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Static to Dynamics 3D Geomechanical Models

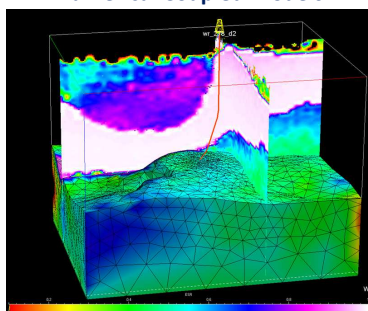


Seismic-based Models



- Static
- High uncertainty
- Low resolution

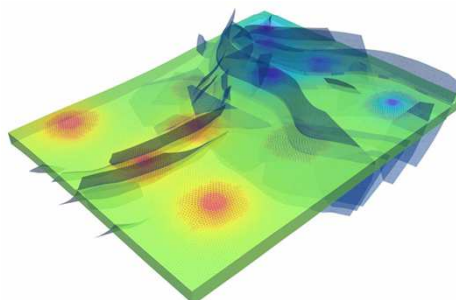
Numerical Coupled Models



- Dynamic
- Coupled with fluid flow
- Low resolution

Thermo-Hydro-Mechanical Models

- Dynamic, powerful and quick
- Higher resolution
- Reduced-order modeling

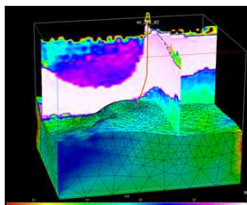


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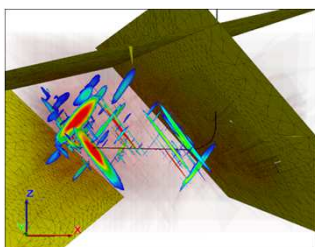
Continuum to Discrete Numerical Models



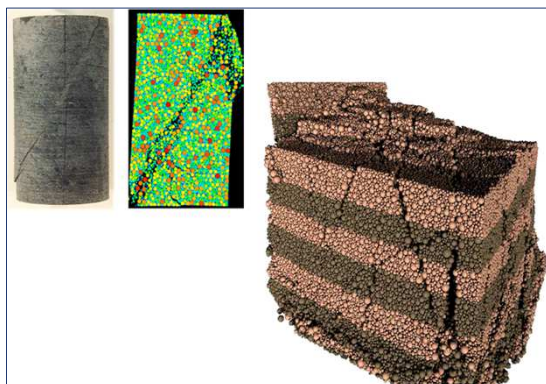
Continuum Models



Discrete Models

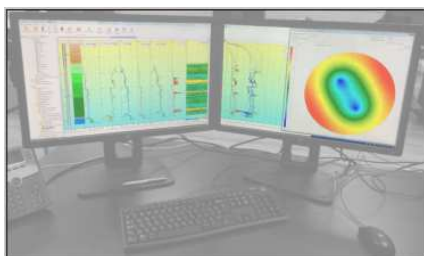


Grain Scale Discrete Models



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Postmortem to Real-time Analysis



- Reduced-order modeling

- Real-time risk identification

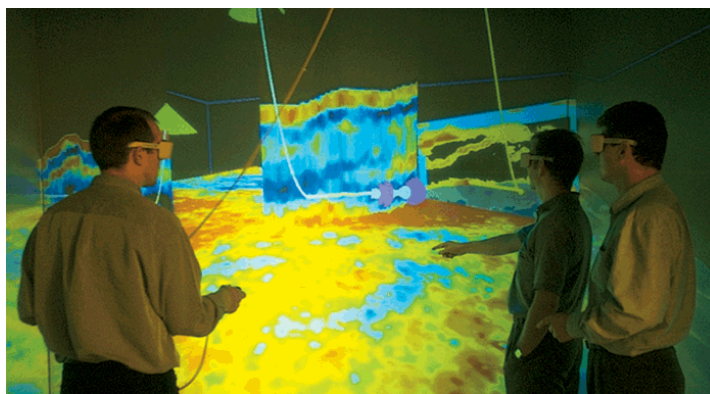
- Collaborative

- Smart real-time decision making

- Processing after each event

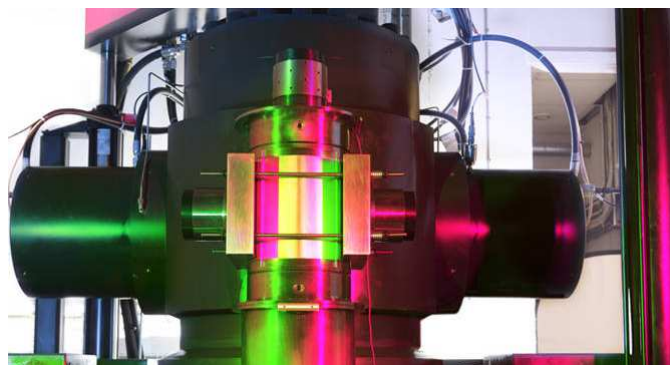
- Time consuming

- Forecasting with uncertainty



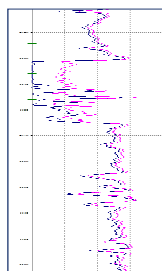
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Triaxial to Poliaxial Testing



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Lab to Field Measurements



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Geomechanics Needs Innovations

Questions?

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