SUBSURFACE ALLIANCE

DATA DRIVEN | SCIENCE BASED | FIT-FOR-PURPOSE

About
Our Company

Discover
What we do

We are a network of subsurface specialists using a Team-of-Teams approach to efficiently solve problems that have a direct business impact in today's fast-paced and evolving energy industry.

We strive to provide high quality subsurface solutions for the energy industry by bridging the gap between geoscience and engineering.

Our Services

We offer comprehensive subsurface services to help mitigate risks at every stage of a project.

01

Geoscience

Integrated multiscale characterization and modeling of reservoir architecture and distributed properties

02

Geomechanics

Physics based modeling of subsurface forces to quantify the stress-strain behavior of geological materials

03

Reservoir simulation

Fluid flow simulation leveraging geological and geomechanical models to reduce uncertainty during field development and production

04

Carbon storage

Comprehensive services to deliver technical requirements for Class VI permitting and mitigate risks associated to long-term storage

05

Fractured reservoirs

Reservoir characterization and simulation of dual porosity models to assess early breakthrough of injected fluids or interaction with hydraulic fractures

06

Geothermal

Integrated evaluation of an evolving in-situ stress field, natural fractures connectivity and its impact on reservoir permeability

We use state-of-the-art geoscience and engineering tools together with specialized workflows to deliver world-class models and superior consulting and training services.

We do not merely look at the problem from a single angle. Our team evaluates each project from a multidisciplinary perspective to identify key drivers and propose the right course of action. By honoring data, we improve the reliability of our predictions while reducing uncertainty.

01

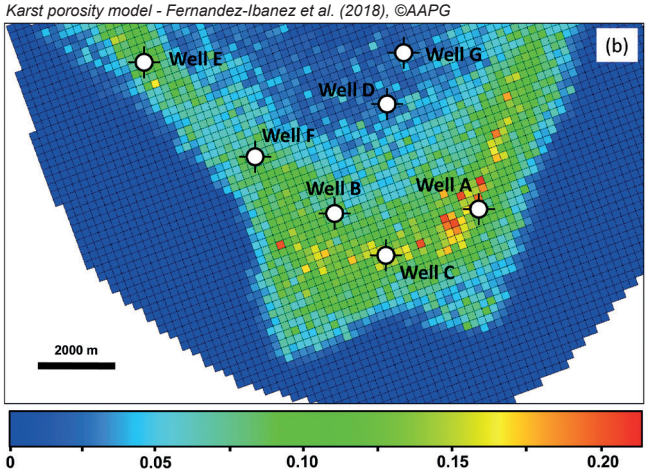
Geoscience

We use a process-based approach to develop geologic concepts. We integrate core, wireline, drilling, well tests, and production data to characterize and model permeability architecture in complex reservoirs.

We specialize in characterization and modeling of complex reservoirs with dual porosity and permeability extremes. Our models help manage the risk associated to early breakthrough of undesired fluids and optimize field development programs.

All around the world, our solutions have saved millions of dollars by helping clients to avoid over-investing in early drilling and under-investing in production facilities, while maximizing the value of information.

Karst porosity model - Fernandez-Ibanez et al. (2018), ©AAPG



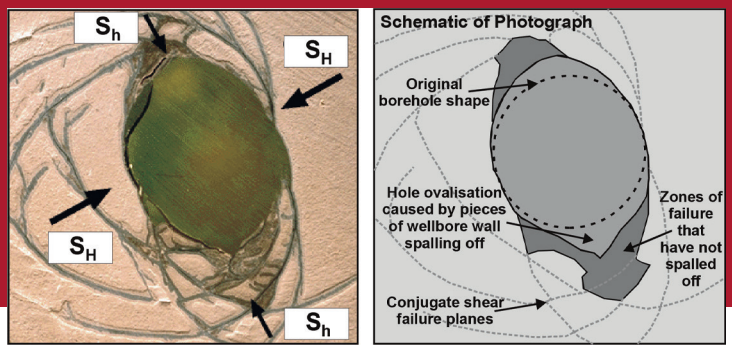
Specialized services

- Core Description
- Image Log Interpretation
- Integration of Core and Image Logs
- Cap Rock Integrity
- Fault Seal and Connectivity
- Fractures and Karst
- Analogs
- Petrophysics
- Rock Typing
- Geocellular Models
- DFN Models
- Well Test Integration
- Field Trips and Training

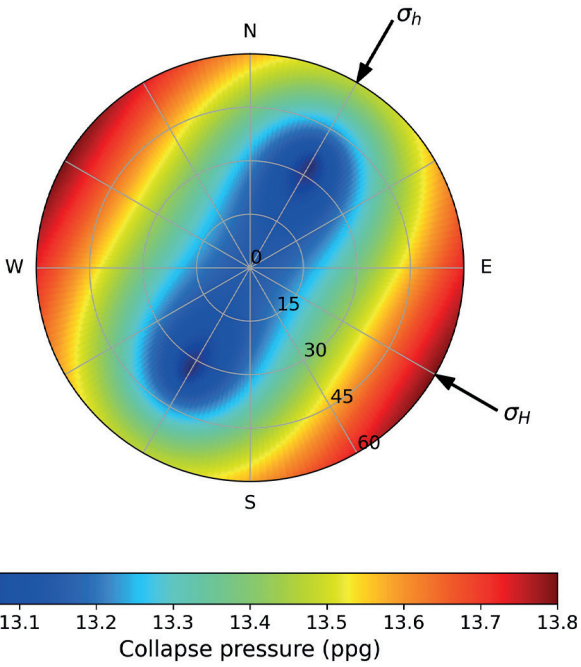
02

Geomechanics

Our approach is robust and effective: we honor the data, select the best constitutive models, and apply scientific workflows to maximize the reliability of our predictions.



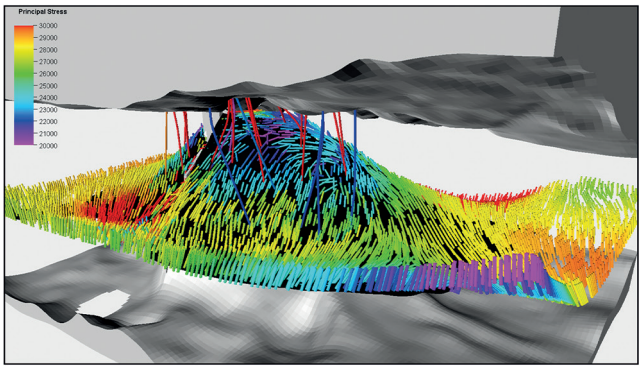
(After Reinecker et al., 2003)



By applying state-of-the-art numerical methods and workflows, we can tackle geomechanics-related issues at any scale, from well-centered to full-field models.

With a second to none track record, our solutions have added millions of dollars to the value chain of subsurface projects, from exploration to appraisal, drilling and completions, development, and abandonment.

3D stress model around a salt dome - Alcalde & Araujo (2017) ©AAPG

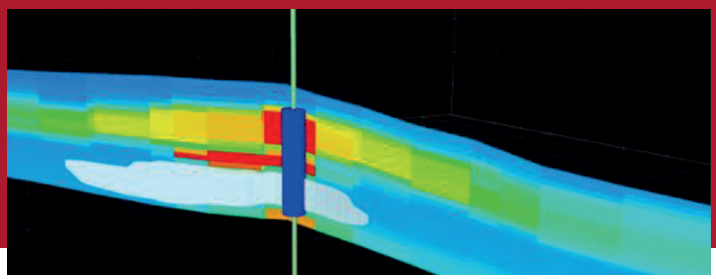


Specialized services

- Pore Pressure
- Fracture Gradient
- Wellbore Stability
- Solids Production Prediction
- Reservoir Compaction
- Fault Stability
- Heave / Subsidence
- Laboratory Tests Design
- Mechanical Skin Assessment
- Well Integrity Analysis

03 Reservoir simulation

We use state-of-the-art fully integrated black-oil/compositional, geomechanics and hydraulic fracturing reservoir simulators to assess plausible scenarios that can result in project under-performance.



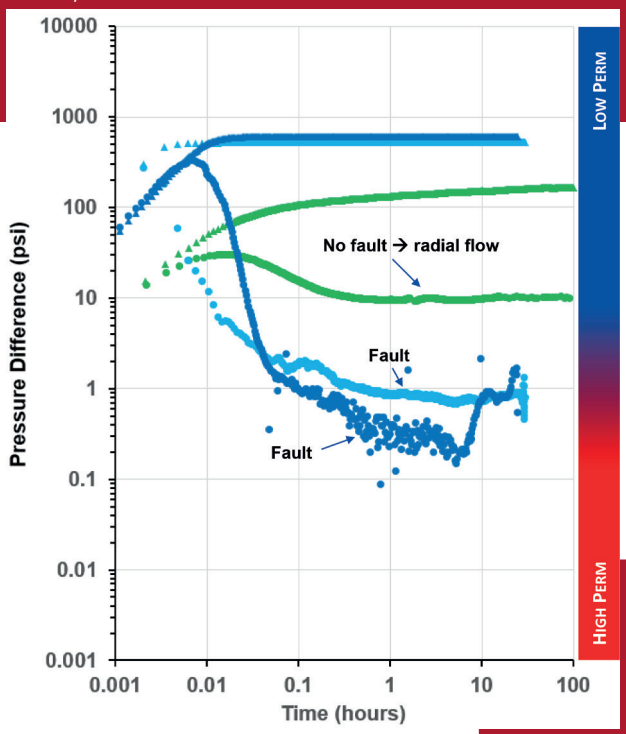
Pressure profile in a polymer-fractured well - Fischer et al. (2017) SPE-185590

We manage the most relevant physics required for conventional and unconventional reservoirs, while maintaining flexibility and enabling fast decision making.

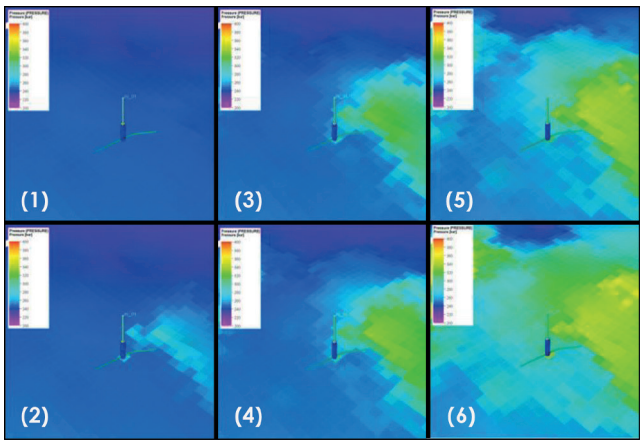
We leverage on the newest computer programing technologies and open-source resources to create dynamic solutions with short innovation cycles.

We can use output flow streams to develop deterministic and probabilistic economic analyses for energy projects under different tax regimes.

Various pressure derivatives from carbonate reservoirs



Pressure distribution over time in a fractured water injection well - Fischer et al. (2017) SPE-185590



Specialized services

- Black Oil/Compositional
- Dual Porosity
- Coupled Geomechanics
- Rock-Fluid Interactions
- Thermal / Chemical EOR
- CCUS and Geothermal
- Hydraulic Fracturing
- Flexibility and Integration
- Uncertainty Analysis
- Optimization Workflows
- Streamlines
- Exploration-to-Production Simulation
- Experience with Main 3D Numerical Simulators

04

Carbon capture and storage (CCS)

Injecting CO_2 in the subsurface is a serious business. EPA Class VI program rules are the strictest in the world and they truly require integration across disciplines. Subsurface Alliance can provide technical expertise and help customers expedite their permitting process.

Technical Services

01 / Faults and fractures

We characterize faults and fractures to assess the likelihood of reactivation or propagation of fractures within and above the confining zone during injection operations.

02 / Geomechanics

We provide a full subsurface stress and pore pressure (1D or 3D) characterization to assess integrity of the confining zone(s) and integrity of injection wells to set safe operational parameters.

03 / Well operability limits

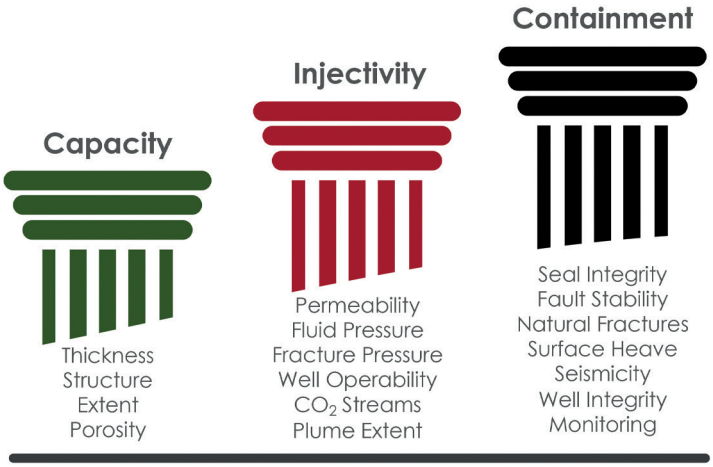
We can assist in calculating the confining zone fracture pressure, to inform injection pressure limits, and assess the physical-chemical characteristics of the injection / sealing zones and its fluids (to evaluate the compatibility between injected fluids and formation fluids and minerals).

04 / Seal integrity

We can assess seal integrity to evaluate the likelihood of fluid migrations across or along faults as well as through the sealing formation that could endanger underground sources of drinking water.

05 / Storage capacity

We can assist in estimating storage and flow capacity of the injection zone using reservoir simulations coupled with geomechanics to assess whether the formation has sufficient volume, porosity and permeability to accommodate the total anticipated volume of CO_2 to be injected at a specified rate.



The 3 Pillars of CCS

05

Fractured reservoirs

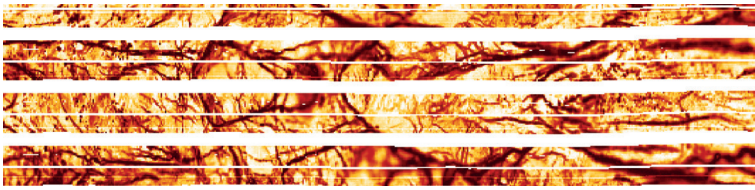
The occurrence of natural fractures in reservoirs provide high permeability pathways that can be several orders of magnitude higher than the background matrix. In low matrix permeability rocks, fractures are critical for economic production of oil & gas and geothermal projects. They can also result in early breakthrough of injected fluids and poor sweep efficiency that negatively impacts ultimate recovery.

Technical Services

01 / Core characterization

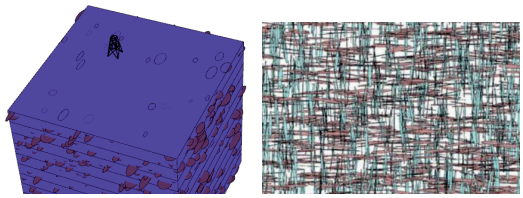
Because fractures are not all formed in the same way, we use core observations to develop a process-based classification which improves predictivity of fractures (intensity and opening) away from well control.

02 / Borehole images



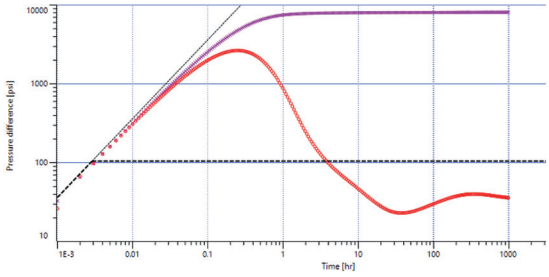
Through integration with core, we develop rules for enhancing image log interpretation, reducing the number of false positive picks, and improving estimates of fracture density and orientation.

03 / Modeling: Geomechanics & DFNs



Geomechanical models are used to predict stress-strain evolution and define areas of higher fracture density. We use quantitative data from core, image logs and numerical models to build Discrete Fracture Network (DFN) models.

04 / Well tests & simulation



We calibrate DFN models using well tests (DST and interference) to fine tune fracture permeability and anisotropy. DFN derived properties of porosity, permeability and sigma factor feed directly into dual porosity reservoir simulations to forecast flow streams and overall reservoir performance under different depletion scenarios. When coupled with geomechanics, it is possible to address fracture network compressibility over time and its economic impact.

06

Geothermal

Geothermal developments, where fluids are injected and then produced, induce temperature and pressure changes that modify the in-situ stress field. Permeability and connectivity across the hot formation, and how this might change under an evolving stress field, is key for the economic success of a project.

Technical Services

01 / In-situ stress

Understanding and constraining the in-situ stress magnitudes and orientations in geothermal fields is of paramount importance for successful and safe drilling operations in hostile high-temperature environments.

02 / Natural fractures

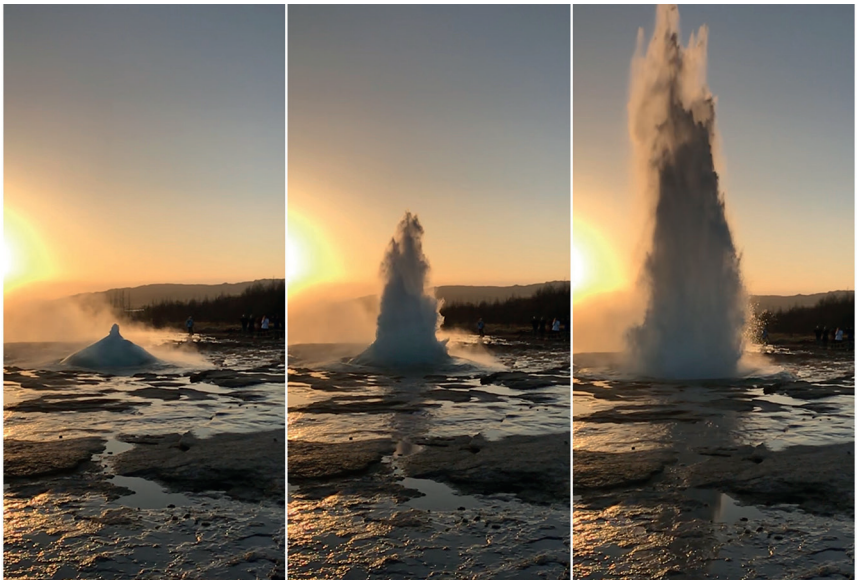
The ability of achieving high injection rates and efficiently circulate fluids between injector and producer often depends on the presence of natural fractures. Characterizing the natural fracture network and its connectivity helps optimize field development.

03 / Thermal stress

Additional stresses arising from the temperature contrast between a cold injected fluid and a hot formation can lead to underestimating the impact of in-situ stresses. Modeling induced thermal stresses can ensure safe drilling operations and predict the impact on stress-sensitive reservoir permeability.

04 / Coupled geomechanics

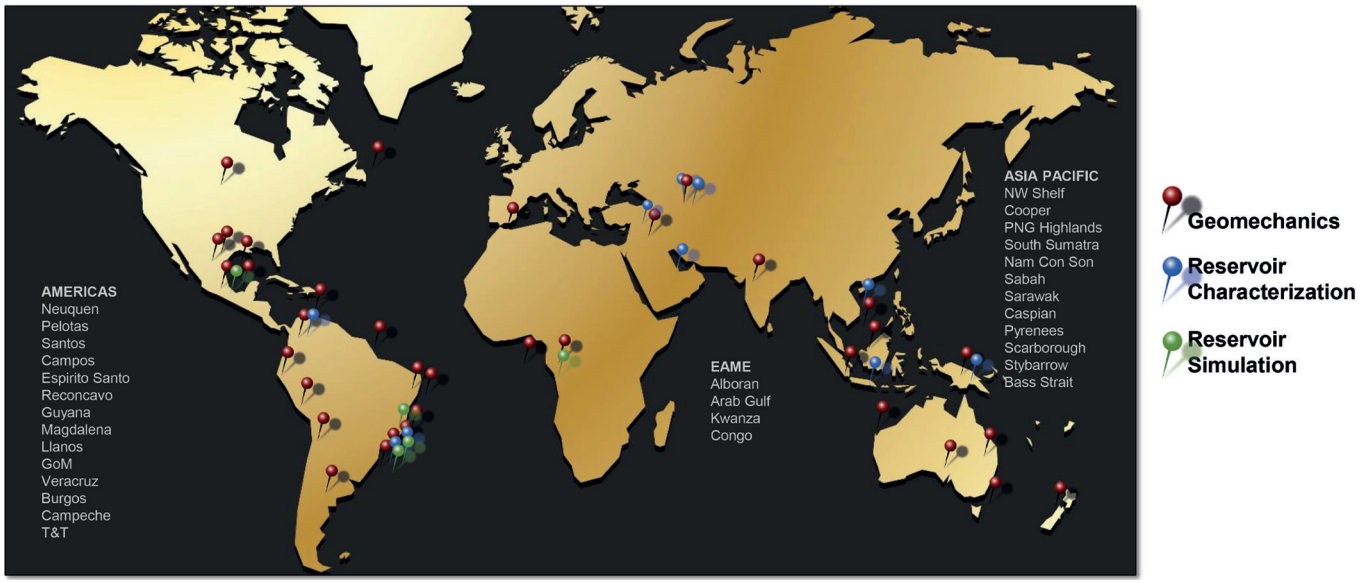
Coupling reservoir and geomechanical simulations can improve reservoir performance prediction while optimizing field development plans. It can also help predict and mitigate collateral effects as induced seismicity and surface heave.



Global Experience

We have 100+ years of combined experience in different basins and plays around the world: from conventional reservoirs to unconventionals, CCS or geothermal; carbonates, clastics or fractured reservoirs.

Our experts bring a broad range of international experience working a variety of world-class projects for major independent operators, always bridging the gap between geoscience and engineering.



Training

At SA we believe that educating clients is the foundation for a long-term relationship, thus, knowledge sharing is always our number one priority.

Our training courses are designed to develop skills and capabilities within organizations. We offer a variety of expert-led training opportunities including traditional in-classroom courses, hands-on experience, field trips, or customized sessions that fits your needs. Some of our most popular classes are Geomechanics 101, Advanced Geomechanics, Excess Permeability in Carbonates or Fractured Reservoirs.

Please reach out to learn more about on training opportunities.
We will find the formula that works best for you!

Relevant Publications

- **Excess Permeability in the Brazil Pre-Salt: Non-matrix Types, Concepts, Diagnostic Indicators, and Reservoir Implications,** 2022: AAPG Bulletin 106 (4).
- **Geomechanical Impacts and Characterization of Collapse Breccia Pipes in Brine Injection Operations,** 2021: 55th U.S. Rock Mechanics/Geomechanics Symposium, ARMA-2021-2056.
- **Borehole Stability in Shale: Beyond Mud Weight,** 2020: IADC/SPE International Drilling Conference and Exhibition, SPE-199596-MS.
- **Optimizing Drawdown Program for a Miocene Field by Applying Geomechanical Modelling to Quantify Casing Integrity Risk,** 2019: 53rd U.S. Rock Mechanics/Geomechanics Symposium, ARMA-2019-1793.
- **Integrating Borehole Image Logs with Core: A Method to Enhance Subsurface Fracture Characterization,** 2018: AAPG Bulletin, v. 102.
- **Assessment of Creep Potential of Gearle Formation for Griffin Field PP&A Planning,** 2018: 52nd U.S. Rock Mechanics/Geomechanics Symposium, ARMA-2018-502.
- **Risk Mitigation on Deepwater Drilling Based on 3D Geomechanics and Fit-for-Purpose Data Acquisition,** 2017: Offshore Technology Conference, OTC-28160-MS.
- **Reducing Fault Reactivation Risk on Deepwater Drilling,** 2017: SPE Latin America & Caribbean Petroleum Engineering Conference, SPE-185619-MS.
- **Integrated Modelling of Formation Damage and Multiple Induced Hydraulic Fractures during Produced Water Reinjection,** 2017: SPE Latin America & Caribbean Pet. Engineering Conference, SPE-185590-MS.
- **Geological and Geomechanical Modeling of the Haynesville Shale: A Full Loop for Unconventional Fractured Reservoirs,** 2016: Unconventional Resources Technology Conference, URTEC-2460295-MS.
- **Using Integrated Geomechanical Study To Resolve Expensive Wellbore Instability Problems While Drilling Through Zubair Shale/Sand Sequence of Kuwait: A Case Study,** 2011: SPE/IADC Middle East Drilling Technology Conference and Exhibition, SPE-148049-MS.
- **Drilling Optimization Using 3D Geomechanical Modeling in the Llanos Orientales Basin, Colombia,** 2010: SPE Latin American and Caribbean Petroleum Engineering Conference, SPE-138752-MS.

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