



# FRACTURED RESERVOIR SERVICES





## UNLOCKING THE POTENTIAL OF YOUR FRACTURED RESERVOIR

Golder Associates has been providing solutions for naturally fractured reservoirs for over three decades. These are notoriously difficult reservoirs to understand. At Golder we bring together our global experience from petroleum, mining, and nuclear waste disposal, combined with unique analytical tools, to provide you with practical, timely solutions.

We have worked on fractured reservoirs from across the world in a wide range of geological settings including fractured carbonates and sandstones, tight shales, CBM, volcanics, and fractured basement rocks.

We are specialists in the development of geologically realistic fracture models and using these for reservoir appraisal, development, engineering, and exploration. Combining a wealth of practical experience with access to our FracMan Discrete Fracture Network (DFN) modeling environment, we can provide you with solutions to your fractured reservoir problems.

So whether its imaging, analysis, modeling, or simulation, Golder can help you unlock the potential of your fractured reservoirs.

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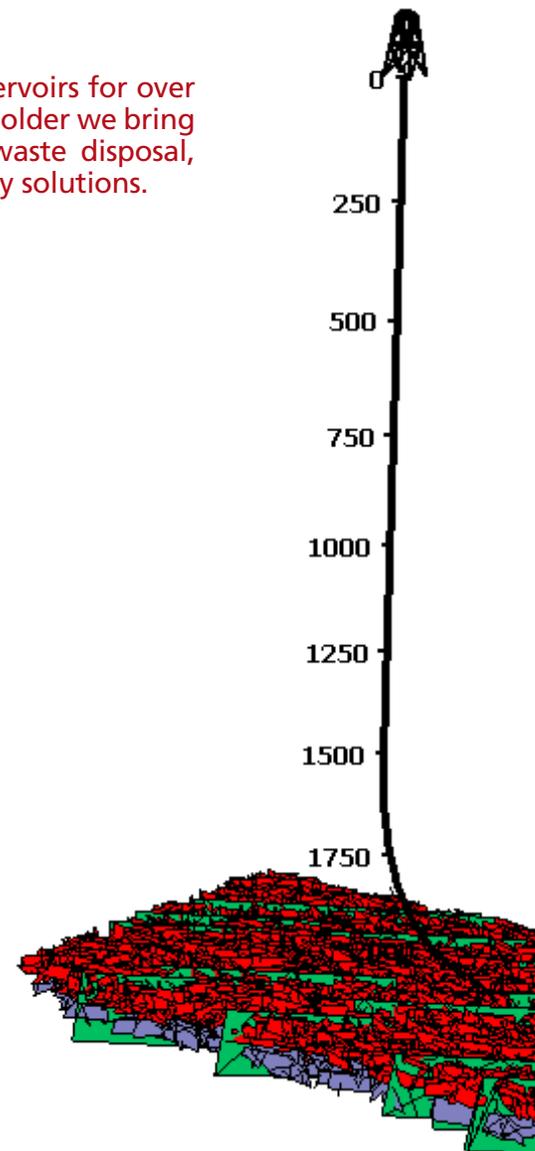
Whether your need is for Fractured Reservoir Consulting, Software or Training, Golder has solutions for you.

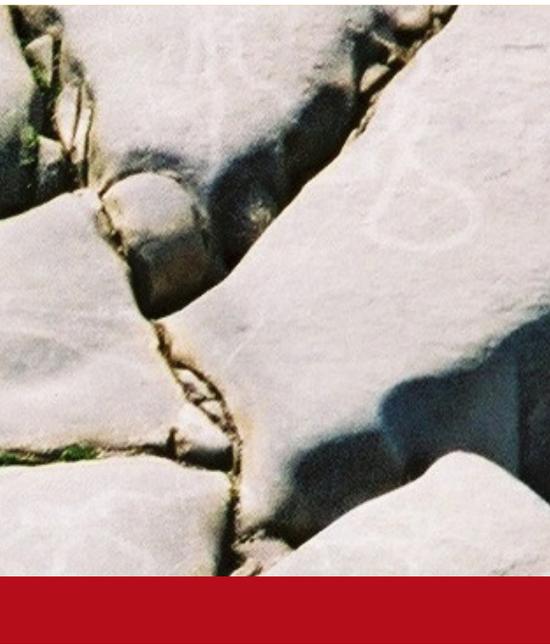
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### NOT ALL FRACTURES ARE EQUAL

One of the keys to developing fractured reservoirs is the identification of the fractures that matter. Golder has over 30 years of practical experience in identifying the key fractures and faults which provide major flow connections, the key faults that provide flow barriers, and the fracture networks that provide fracture permeability and porosity. Golder's unique technologies make it possible to understand these key fractures by interpreting well and reservoir dynamics, geophysics, and geology. Your fractured assets will be more productive when you know the fractures that matter.

At the heart of Golder's fractured reservoir expertise is the FracMan DFN software. This is based upon over thirty years of development and the world's first commercial DFN code. Countless reservoirs around the world have been modelled and optimized, based upon the power of FracMan and its ability to integrate all of your static and dynamic fracture information into a unified description of your reservoir fracture system.





# HOW CAN GOLDER HELP YOU?

## FRACTURED RESERVOIR ANALYSIS AND MODELING

As specialists in the analysis and synthesis of a wide range of both static and dynamic reservoir fracture data, Golder can help you better understand your fractured reservoir. Whether you're looking for a basic conceptual understanding, identification of drilling targets, volumetrics, fracture permeability calculation, well scale, sector scale, or full field fracture model development, Golder can help.

## WELL TEST ANALYSIS & SIMULATION

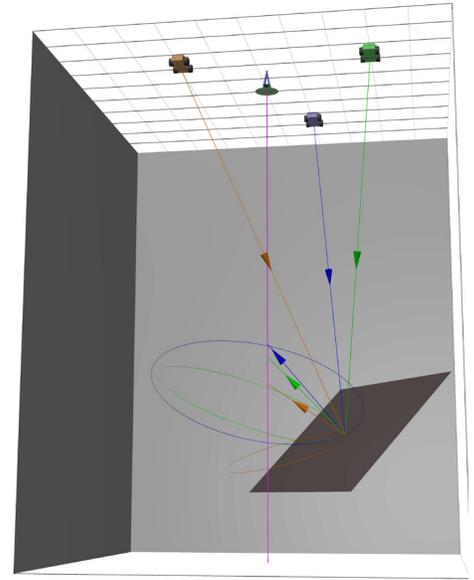
Our knowledge and experience can help you resolve such issues as fracture permeability, porosity, and connectivity. Golder has been central to many of the developments in understanding fractured rock hydraulics. From working across a wide range of industries, we have developed unique insights into the flow potential of fractured reservoirs that can be unlocked using our well test analysis and simulation tools.

## SPECIALIST SEISMIC PROCESSING, IMAGING & INTERPRETATION

Whether you need help interpreting the latest in fracture sensitive seismic attributes, improving the quality of seismic volumes to aid interpretation, processing VSP data for fracture imaging, or interpreting micro-seismic emissions, Golder can help.

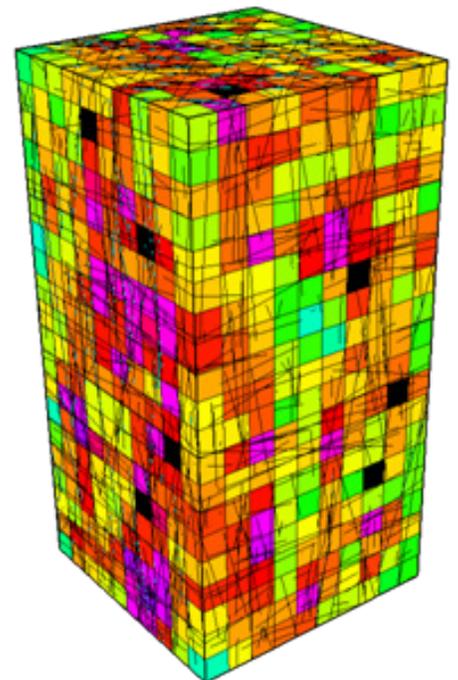
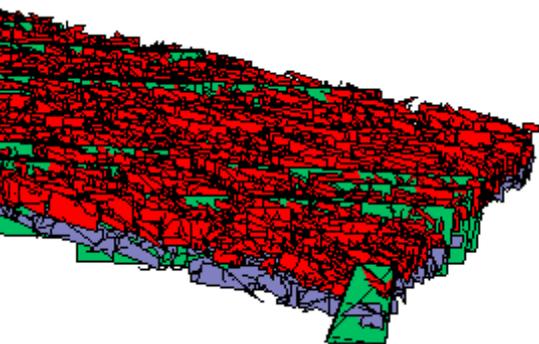
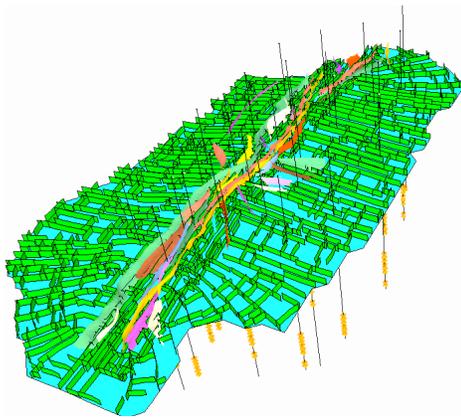
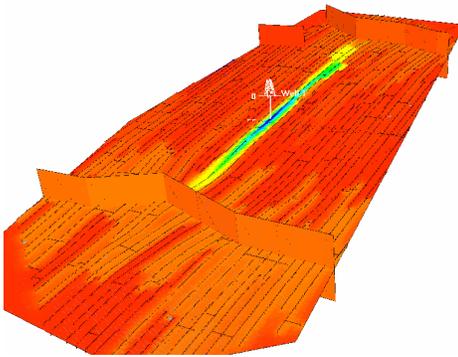
## FIELD DEVELOPMENT PLANNING AND RESERVOIR SIMULATION

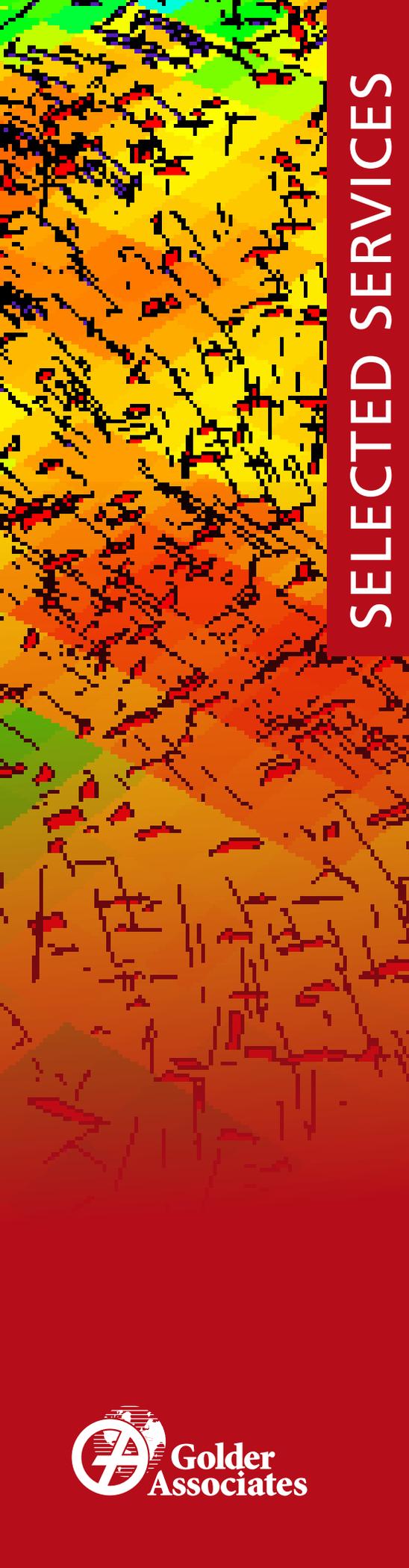
Will infill drilling yield cost-effective reserve additions? How many wells will be needed to achieve the target production rates and where should they be located? Golder and our partners have helped companies develop plans for maximizing recovery and achieving production targets in complex fractured reservoirs throughout the world using industry-leading dual-porosity, dual-permeability and multiphase native DFN simulation software, supported by conventional simulation studies.



## RESERVOIR GEOMECHANICS

Our specialists can provide integrated petroleum geomechanics consulting services to address a wide range of issues including stress effects on recovery, sand production management, well and caprock integrity assessment, compaction / subsidence / heave assessment, formation damage, and borehole stability analysis. Supported by both laboratory and modeling capabilities, Golder can help.





# SELECTED SERVICES

## FRACTURED RESERVOIR ANALYSIS & MODELING

- Reservoir Structural Geology
- Discrete Fracture Network (DFN) Static Modeling
- Fractured Reservoir Architecture Assessment
- Upscaling of Fracture Permeability
- Fracture Porosity Analysis
- Anisotropy and Heterogeneity
- Fracture Image Log Extrapolation
- Fracture Statistical, Geostatistical and Fractal Analysis
- Critical Stress Analysis

## GEOPHYSICAL SERVICES

- Vertical Seismic Profiling (VSP) processing & interpretation
- Micro Seismic Surveys and Interpretation
- Seismic Volume Reprocessing
- Identification of Fractures and Faults from Seismic Surveys
- Fracture Intensity and Orientation Fields Conditioning

## FRACTURED RESERVOIR ENGINEERING AND FIELD DEVELOPMENT

- Well Test Design, Interpretation and Simulation
- Development Strategies
- Well Location, Completion, and Trajectory Optimization
- Uncertainty Analysis and Risk Assessment
- IOR Strategy Development
- Reservoir Volumetrics
- Tributary Drainage Volume Analysis
- Matrix-Fracture Interaction Assessment
- True Multiple Porosity / Multiple Permeability Dynamic Simulation
- Production Test, PLT, and DST Analysis and Interpretation
- Multiphase Discrete Fracture Network Flow Modeling
- Calibration and Conditioning to Dynamic Data

## RESERVOIR GEOMECHANICS

- Hydraulic Fracture Stress Interpretation
- Insitu and Critical Stress Analysis
- Coupled Stress-Hydrodynamic Analysis
- Sand Production Management
- Well and Cap Rock Integrity Assessment
- Compaction / Subsidence / Heave Investigation
- Wellbore Stability Analysis

## HYDRAULIC FRACTURE MODELLING

- Full 3D analysis
- Multistage hydraulic fracture stimulation
- Microseismic data matching
- Infill strategies
- Optimize completion and hydraulic fracturing strategies
- Simulated post-frac production
- Evaluation of exploration prospects



ENGINEERING EARTH'S DEVELOPMENT, PRESERVING EARTH'S INTEGRITY.

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