

# Mechanics of Hydraulic Fracturing

Experiment, Model, and Monitoring

Edited by Xi Zhang • Bisheng Wu  
Diansen Yang • Andrew Bungler



WILEY

# Mechanics Of Hydraulic Fracturing

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## **Mechanics Of Hydraulic Fracturing:**

**Mechanics of Hydraulic Fracturing** Xi Zhang, Bisheng Wu, Diansen Yang, Andrew Bunger, 2022-12-15 Mechanics of Hydraulic Fracturing Comprehensive single volume reference work providing an overview of experimental results and predictive methods for hydraulic fracture growth in rocks Mechanics of Hydraulic Fracturing Experiment Model and Monitoring provides a summary of the research in mechanics of hydraulic fractures during the past two decades plus new research trends to look for in the future The book covers the contributions from theory modeling and experimentation including the application of models to reservoir stimulation mining preconditioning and the formation of geological structures The four expert editors emphasize the variety of diverse methods and tools in hydraulic fracturing and help the reader understand hydraulic fracture mechanics in complex geological situations To aid in reader comprehension practical examples of new approaches and methods are presented throughout the book Key topics covered in the book include Prediction of fracture shapes sizes and distributions in sedimentary basins plus their importance in petroleum industry Real time monitoring methods such as micro seismicity and trace tracking How to uncover geometries of fractures like dikes and veins Fracture growth of individual foundations and its applications Researchers and professionals working in the field of fluid driven fracture growth will find immense value in this comprehensive reference on hydraulic fracturing mechanics

**Mechanics of Hydraulic Fracturing** Ching H. Yew, 1997-03-31 This book examines the underlying mechanics of creating a fracture from vertical or deviated wellbores and the propagation of a hydraulic fracture in the reservoir

**Hydraulic Fracturing and Rock Mechanics** Yu Zhao, Yongfa Zhang, Pengfei He, 2023-06-21 This open access book is the first to consider the effect of non uniform fluid pressure in hydraulic fractures The book covers the key topics in the process of hydraulic fracture nucleation growth interaction and fracture network formation Laboratory experiments and theoretical modeling are combined to elucidate the formation mechanism of complex fracture networks This book is suitable for master s Ph D students scientists and engineers majoring in rock mechanics and petroleum engineering who need to use a more reliable model to predict fracture behavior **Hydraulic Fracture Mechanics** Peter Valkó, Michael J.

Economides, 1995 The book explores the theoretical background of one of the most widespread activities in hydrocarbon wells that of hydraulic fracturing A comprehensive treatment of the basic phenomena includes linear elasticity stresses fracture geometry and rheology The diverse concepts of mechanics are integrated into a coherent description of hydraulic fracture propagation The chapters in the book are cross referenced throughout and the connections between the various phenomena are emphasized The book offers readers a unique approach to the subject with the use of many numerical examples **The Fluid Mechanics of Hydraulic Fracturing** Craig Warren Gustafson, 1987 **The Mechanics of**

**Fluid-Driven Fractures: Theory and Applications** Emmanuel Detournay, Jose I. Adachi, Dmitry I. Garagash, 2015-05-04 Answers to basic questions have remained elusive despite the publications that this subject has attracted How is a fracture

evolving in shape and size How is the fracturing pressure varying with time What is the process dependence on the properties of the soils or rock on the in situ stresses on the properties of both the fracturing fluid and the pore fluid and on the boundary conditions In particular Hydraulic Fracture Mechanics by Valko and Economides was a good treatment of the applied mechanics of the subject at the time it was written 1995 but much of the material has been developed since then in a more theoretical way The proposed book is based on recent efforts by the authors to derive accurate solutions for fluid driven fractures Key Features of the book include Focuses on the fundamentals of fluid driven fractures Fluid driven fracturing is an essential technique in the petroleum industry Brings new answers to a difficult problem     Imaging the Mechanics of Hydraulic Fracturing in Naturally-fractured Reservoirs Using Induced Seismicity and Numerical Modeling Xueping Zhao,2010     *Porous Rock Fracture Mechanics* Amir Shojaei,Jianfu Shao,2017-05-05 Porous Rock Failure Mechanics Hydraulic Fracturing Drilling and Structural Engineering focuses on the fracture mechanics of porous rocks and modern simulation techniques for progressive quasi static and dynamic fractures The topics covered in this volume include a wide range of academic and industrial applications including petroleum mining and civil engineering Chapters focus on advanced topics in the field of rock s fracture mechanics and address theoretical concepts experimental characterization numerical simulation techniques and their applications as appropriate Each chapter reflects the current state of the art in terms of the modern use of fracture simulation in industrial and academic sectors Some of the major contributions in this volume include but are not limited to anisotropic elasto plastic deformation mechanisms in fluid saturated porous rocks dynamics of fluids transport in fractured rocks and simulation techniques fracture mechanics and simulation techniques in porous rocks fluid structure interaction in hydraulic driven fractures advanced numerical techniques for simulation of progressive fracture including multiscale modeling and micromechanical approaches for porous rocks and quasi static versus dynamic fractures in porous rocks This book will serve as an important resource for petroleum geomechanics drilling and structural engineers R D managers in industry and academia Includes a strong editorial team and quality experts as chapter authors Presents topics identified for individual chapters are current relevant and interesting Focuses on advanced topics such as fluid coupled fractures rock s continuum damage mechanics and multiscale modeling Provides a one stop advanced level reference for a graduate course focusing on rock s mechanics     Fracture Mechanics of Rock Atkinson,1987-01-28 Fracture Mechanics of Rock     *Rock Fracture Mechanics* H.P. Rossmanith,2014-05-04     **Hydraulic fracturing and geothermal energy** S. Nemat-Nassar,H. Abé,S. Hirakawa,1983-07-31 Hydraulic fracturing has been and continues to be a major technological tool in oil and gas recovery nuclear and other waste disposal mining and particularly in situ coal gasification and more recently in geothermal heat recovery particularly extracting heat from hot dry rock masses The understanding of the fracture process under the action of pressurized fluid at various temperatures is of fundamental scientific importance which requires an adequate description of thermomechanical properties of subsurface rock fluid solid interaction effects as well as degradation

of the host rock due to temperature gradients introduced by heat extraction. Considerable progress has been made over the past several years in laboratory experiments, analytical and numerical modeling and in situ field studies in various aspects of hydraulic fracturing and geothermal energy extraction by researchers in the United States and Japan and also elsewhere. However, the results have been scattered throughout the literature. Therefore, the time seemed ripe for bringing together selected researchers from the two countries as well as observers from other countries in order to survey the state of the art, exchange scientific information and establish closer collaboration for further better coordinated scientific effort in this important area of research and exploration.

**Geomechanics and Hydraulic Fracturing for Shale Reservoirs** Yu Wang, 2020-07-01. This book is intended as a reference book for advanced graduate students and research engineers in shale gas development or rock mechanical engineering. Globally, there is widespread interest in exploiting shale gas resources to meet rising energy demands, maintain energy security and stability in supply and reduce dependence on higher carbon sources of energy, namely coal and oil. However, extracting shale gas is a resource intensive process and is dependent on the geological and geomechanical characteristics of the source rocks, making the development of certain formations uneconomic using current technologies. Therefore, evaluation of the physical and mechanical properties of shale together with technological advancements is critical in verifying the economic viability of such formation. Accurate geomechanical information about the rock and its variation through the shale is important since stresses along the wellbore can control fracture initiation and frac development. In addition, hydraulic fracturing has been widely employed to enhance the production of oil and gas from underground reservoirs. Hydraulic fracturing is a complex operation in which the fluid is pumped at a high pressure into a selected section of the wellbore. The interaction between the hydraulic fractures and natural fractures is the key to fracturing effectiveness, prediction and high gas development. The development and growth of a hydraulic fracture through the natural fracture systems of shale is probably more complex than can be described here but may be somewhat predictable if the fracture system and the development of stresses can be explained. As a result, comprehensive shale geomechanical experiments, physical modeling, experiment and numerical investigations should be conducted to reveal the fracturing mechanical behaviors of shale.

*Fracture Mechanics Analysis of the Validity of Hydraulic Fracturing as a Technique of In-situ Stress Determination* Gideon Leonard, 1985. **Hydraulic Fracturing in Inclined Boreholes** Narayanan Harikrishnan, 1994. Hydraulic Fracturing: a Fracture Mechanics Approach J. D. McLennan, 1980.

**Hydraulic Fracture Modeling** Yu-Shu Wu, 2017-11-30. Hydraulic Fracture Modeling delivers all the pertinent technology and solutions in one product to become the go-to source for petroleum and reservoir engineers. Providing tools and approaches, this multi-contributed reference presents current and upcoming developments for modeling rock fracturing, including their limitations and problem-solving applications. Fractures are common in oil and gas reservoir formations and with the ongoing increase in development of unconventional reservoirs, more petroleum engineers today need to know the

latest technology surrounding hydraulic fracturing technology such as fracture rock modeling There is tremendous research in the area but not all located in one place Covering two types of modeling technologies various effective fracturing approaches and model applications for fracturing the book equips today's petroleum engineer with an all inclusive product to characterize and optimize today's more complex reservoirs Offers understanding of the details surrounding fracturing and fracture modeling technology including theories and quantitative methods Provides academic and practical perspective from multiple contributors at the forefront of hydraulic fracturing and rock mechanics Provides today's petroleum engineer with model validation tools backed by real world case studies

**Fracture Mechanics Applied to Hydraulic Fracturing in**

**Laboratory Experiments** Ferdinand Stöckhert, 2015      *Applications of Rock Fracture Mechanics* Michael P.

Cleary, Massachusetts Institute of Technology. Resource Extraction Laboratory, 1983

**Modelling Rock Fracturing**

**Processes** Baotang Shen, Ove Stephansson, Mikael Rinne, 2020-05-06 This book is the second edition of the well known textbook *Modelling Rock Fracturing Processes* The new and extended edition provides the theoretical background of rock fracture mechanics used for modelling of 2 D and 3 D geomechanics problems and processes Fundamentals of rock fracture mechanics integrated with experimental studies of rock fracturing processes are highlighted The computer programs FRACOD 2D and 3D are used to analyse fracture initiation and propagation for the three fracture modes Mode I II and III Coupled fracture modelling with other continuous and distinct element codes including FLAC PFC RFPA TOUGH are also described A series of applications of fracture modelling with importance for modern society is presented and discussed by distinguished rock fracture modelling experts

**Fracture Mechanics Analysis of the Validity of Hydraulic Fracturing as a Technique of In-situ Stress Determination** Gideon Leonard, 1985

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## **Table of Contents Mechanics Of Hydraulic Fracturing**

1. Understanding the eBook Mechanics Of Hydraulic Fracturing
  - The Rise of Digital Reading Mechanics Of Hydraulic Fracturing
  - Advantages of eBooks Over Traditional Books
2. Identifying Mechanics Of Hydraulic Fracturing
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Mechanics Of Hydraulic Fracturing
  - User-Friendly Interface
4. Exploring eBook Recommendations from Mechanics Of Hydraulic Fracturing
  - Personalized Recommendations
  - Mechanics Of Hydraulic Fracturing User Reviews and Ratings
  - Mechanics Of Hydraulic Fracturing and Bestseller Lists
5. Accessing Mechanics Of Hydraulic Fracturing Free and Paid eBooks
  - Mechanics Of Hydraulic Fracturing Public Domain eBooks
  - Mechanics Of Hydraulic Fracturing eBook Subscription Services
  - Mechanics Of Hydraulic Fracturing Budget-Friendly Options

6. Navigating Mechanics Of Hydraulic Fracturing eBook Formats
  - ePub, PDF, MOBI, and More
  - Mechanics Of Hydraulic Fracturing Compatibility with Devices
  - Mechanics Of Hydraulic Fracturing Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Mechanics Of Hydraulic Fracturing
  - Highlighting and Note-Taking Mechanics Of Hydraulic Fracturing
  - Interactive Elements Mechanics Of Hydraulic Fracturing
8. Staying Engaged with Mechanics Of Hydraulic Fracturing
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Mechanics Of Hydraulic Fracturing
9. Balancing eBooks and Physical Books Mechanics Of Hydraulic Fracturing
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Mechanics Of Hydraulic Fracturing
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Mechanics Of Hydraulic Fracturing
  - Setting Reading Goals Mechanics Of Hydraulic Fracturing
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Mechanics Of Hydraulic Fracturing
  - Fact-Checking eBook Content of Mechanics Of Hydraulic Fracturing
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements



- Interactive and Gamified eBooks

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