Geomechanical And Petrophysical Properties Of Mudrocks

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.

The Longmaxi Formation, in the Middle and Upper Yangtze region of China, has much potential for exploration and commercial resource development. This thesis characterizes the Longmaxi marine shale using well logs from two vertical wells and three horizontal wells in the southern Sichuan Basin, China. Geomechanical properties were determined by log data. The maximum permissible hydraulic fracturing net pressure with respect to the maximum fracture height was predicted. According to the log curves in the two vertical wells, there are two apparent boundaries in the Longmaxi Formation. Above the first boundary, the upper lime mudstone and limestone zone are located at the top of an organic shale layer. Below the organic shale zone is a limestone zone. The well logs show low porosity (average 6%) in the organic gas-bearing shale layer. Free gas accounts for about 50% of the total gas. The layer is high in quartz content (50%) and low in clay content (20%). These percentages indicate that the Lower Silurian Longmaxi Formation is brittle, and the lower mechanical moduli of the organic shale layer compared to the adjacent rock layers suggests the ability of this interval to contain the induced fractures. This constrains fracture propagation within the gas-bearing shale layers with respect to the fixed production rate and treatment pressure. According to my results, the maximum permissible net treatment pressure of vertical Well 1 in the fracture is 12.9 MPa, whereas in vertical Well 2 the maximum permissible net pressure is 4.5 MPa because of its thinner shale layer thickness compared to conditions in vertical Well 1.

The interpretation of geophysical data in exploration geophysics, well logging, engineering, mining and environmental geophysics

requires knowledge of the physical properties of the rocks and their correlation. Physical properties are a "key" for combined interpretation techniques. The study of rock physics provides an interdisciplinary treatment of physical properties, whether related to geophysical, geotechnical, hydrological or geological methodology. The book is a comprehensive and concise systematic presentation of the physical properties of rocks. It is focussed on the problems of applied geophysics with respect to exploration and the expanding field of applications in engineering and mining geophysics, geotechnics, hydrology and environmental problems, and the properties under the conditions of the upper earth crust. This volume contains theoretical and experimental results relating to the main geophysical properties - density, magnetic properties, natural radioactivity, elastic and anelastic properties, electrical and thermal. It also presents the correlation between the individual properties as a basis of modern interpretation methods, including relationships between geophysical and geotechnical properties.

The interpretation of geophysical data in exploration geophysics, well logging, engineering, mining and environmental geophysics requires knowledge of the physical properties of rocks and their correlations. Physical properties are a "key" for combined interpretation techniques. The study of rock physics provides an interdisciplinary treatment of physical properties, whether related to geophysical, geotechnical, hydrological or geological methodology. Physical Properties of Rocks, 2nd Edition, describes the physical fundamentals of rock properties, based on typical experimental results and relevant theories and models. It provides readers with all relevant rock properties and their interrelationships in one concise volume. Furthermore, it guides the reader through experimental and theoretical knowledge in order to handle models and theories in practice. Throughout the book the author focuses on the problems of applied geophysics with respect to exploration and the expanding field of applications in engineering and mining geophysics, geotechnics, hydrology and environmental problems, and the properties under the conditions of the upper Earth crust. Physical Properties of Rocks, Second Edition, guides readers through a systematic presentation of all relevant physical properties and their interrelationships in parallel with experimental and theoretical basic knowledge and a guide for handling core models and theories

Core Analysis: A Best Practice Guide is a practical guide to the design of core analysis programs. Written to address the need for an updated set of recommended practices covering special core analysis and geomechanics tests, the book also provides unique insights into data quality control diagnosis and data utilization in reservoir models. The book's best practices and procedures benefit petrophysicists, geoscientists, reservoir engineers, and production engineers, who will find useful information on core data in reservoir static and dynamic models. It provides a solid understanding of the core analysis procedures and methods used by commercial laboratories, the details of lab data reporting required to create quality control tests, and the diagnostic plots and protocols that can be used to identify suspect or erroneous data. Provides a practical overview of core analysis, from coring at the well site to laboratory data acquisition and interpretation Defines current best practice in core analysis preparation and test procedures, and the diagnostic tools used to quality control core data Provides essential information on design of core analysis programs and to judge the quality and reliability of core analysis data ultimately used in reservoir evaluation Of specific interest to

those working in core analysis, porosity, relative permeability, and geomechanics

Geomechanics investigates the origin, magnitude and deformational consequences of stresses in the crust. In recent years awareness of geomechanical processes has been heightened by societal debates on fracking, human-induced seismicity, natural geohazards and safety issues with respect to petroleum exploration drilling, carbon sequestration and radioactive waste disposal. This volume explores the common ground linking geomechanics with inter alia economic and petroleum geology, structural geology, petrophysics, seismology, geotechnics, reservoir engineering and production technology. Geomechanics is a rapidly developing field that brings together a broad range of subsurface professionals seeking to use their expertise to solve current challenges in applied and fundamental geoscience. A rich diversity of case studies herein showcase applications of geomechanics to hydrocarbon exploration and field development, natural and artificial geohazards, reservoir stimulation, contemporary tectonics and subsurface fluid flow. These papers provide a representative snapshot of the exciting state of geomechanics and establish it firmly as a flourishing subdiscipline of geology that merits broadest exposure across the academic and corporate geosciences.

Geomechanics and Geodynamics of Rock Masses contains contributions presented at EUROCK 2018, the 2018 International Symposium of the International Society for Rock Mechanics (ISRM 2018, Saint Petersburg, Russia, 22-26 May 2018). Dedicated to recent advances and achievements in the fields of geomechanics and geotechnology, the main topics of the book include: - Physical and mechanical properties of fractured rock (laboratory testing and rock properties, field measurements and site investigations) - Geophysics in rock mechanics - Rock mass strength and failure - Nonlinear problems in rock mechanics - Effect of joint water on the behavior of rock foundation - Numerical modeling and back analysis - Mineral resources development: methods and rock mechanics problems - Rock mechanics and underground construction in mining, hydropower industry and civil engineering - Rock mechanics in petroleum engineering - Geodynamics and monitoring of rock mass behavior - Risks and hazards - Geomechanics of technogenic deposits Geomechanics and Geodynamics of Rock Masses will be of interest to researchers and professionals involved in the various branches of rock mechanics and rock engineering. EUROCK 2018, organized by the Saint Petersburg Mining University, is a continuation of the successful series of ISRM symposia in Europe, which began in 1992 in Chester, UK.

Applied Petroleum Geomechanics provides a bridge between theory and practice as a daily use reference that contains direct industry applications. Going beyond the basic fundamentals of rock properties, this guide covers critical field and lab tests, along with interpretations from actual drilling operations and worldwide case studies, including abnormal formation pressures from many major petroleum basins. Rounding out with borehole stability solutions and the geomechanics surrounding hydraulic fracturing and unconventional reservoirs, this comprehensive resource gives petroleum engineers a much-needed guide on how to tackle today’s advanced oil and gas operations. Presents methods in formation evaluation and the most recent advancements in the area, including tools, techniques and success stories

Bridges the gap between theory of rock mechanics and practical oil and gas applications Helps readers understand pore pressure calculations and predictions that are critical to shale and hydraulic activity

Rock Mechanics for Natural Resources and Infrastructure Development contains the proceedings of the 14th ISRM International Congress (ISRM 2019, Foz do Iguaçu, Brazil, 13-19 September 2019). Starting in 1966 in Lisbon, Portugal, the International Society for Rock Mechanics and Rock Engineering (ISRM) holds its Congress every four years. At this 14th occasion, the Congress brings together researchers, professors, engineers and students around contemporary themes relevant to rock mechanics and rock engineering. Rock Mechanics for Natural Resources and Infrastructure Development contains 7 Keynote Lectures and 449 papers in ten chapters, covering topics ranging from fundamental research in rock mechanics, laboratory and experimental field studies, and petroleum, mining and civil engineering applications. Also included are the prestigious ISRM Award Lectures, the Leopold Muller Award Lecture by professor Peter K. Kaiser. and the Manuel Rocha Award Lecture by Dr. Quinghua Lei. Rock Mechanics for Natural Resources and Infrastructure Development is a must-read for academics, engineers and students involved in rock mechanics and engineering. Proceedings in Earth and geosciences - Volume 6 The ‘Proceedings in Earth and geosciences’ series contains proceedings of peer-reviewed international conferences dealing in earth and geosciences. The main topics covered by the series include: geotechnical engineering, underground construction, mining, rock mechanics, soil mechanics and hydrogeology.

This book is Volume 2 of the EUROCK 2018 proceedings. Geomechanics and Geodynamics of Rock Masses contains contributions presented at EUROCK 2018, the 2018 International Symposium of the International Society for Rock Mechanics (ISRM 2018, Saint Petersburg, Russia, 22-26 May 2018). Dedicated to recent advances and achievements in the fields of geomechanics and geotechnology, the main topics of the book include: - Physical and mechanical properties of fractured rock (laboratory testing and rock properties, field measurements and site investigations) - Geophysics in rock mechanics - Rock mass strength and failure - Nonlinear problems in rock mechanics - Effect of joint water on the behavior of rock foundation - Numerical modeling and back analysis - Mineral resources development: methods and rock mechanics problems - Rock mechanics and underground construction in mining, hydropower industry and civil engineering - Rock mechanics in petroleum engineering - Geodynamics and monitoring of rock mass behavior - Risks and hazards - Geomechanics of technogenic deposits Geomechanics and Geodynamics of Rock Masses will be of interest to researchers and professionals involved in the various branches of rock mechanics and rock engineering. EUROCK 2018, organized by the Saint Petersburg Mining University, is a continuation of the successful series of ISRM symposia in Europe, which began in 1992 in Chester, UK.

Fundamentals of Enhanced Oil and Gas Recovery from Conventional and Unconventional Reservoirs delivers the proper foundation on all types of currently utilized and upcoming enhanced oil recovery, including methods used in emerging unconventional reservoirs. Going beyond traditional secondary methods, this reference includes advanced water-based EOR methods which are becoming more popular due to CO2 injection methods used in EOR and methods specific to target shale oil and gas activity. Rounding out with a chapter devoted to optimizing the application and economy of EOR methods, the book brings reservoir and petroleum engineers up-to-speed on the latest studies to apply. Enhanced oil recovery continues to grow in technology, and with ongoing unconventional reservoir activity underway, enhanced oil recovery methods of many kinds will continue to gain in studies and scientific advancements. Reservoir engineers currently have multiple outlets to gain knowledge and are in need of one product go-to reference. Explains enhanced oil recovery methods, focusing specifically on those used for unconventional reservoirs Includes real-world case studies and examples to further illustrate points Creates a practical and theoretical foundation with multiple contributors from various backgrounds Includes a full range of the latest and future methods for enhanced oil recovery, including chemical, waterflooding, CO2 injection and thermal

A symbiosis of a brief description of physical fundamentals of the rock properties (based on typical experimental results and relevant theories and models) with a guide for practical use of different theoretical concepts.

Unconventional Oil and Gas Resources Handbook: Evaluation and Development is a must-have, helpful handbook that brings a wealth of information to engineers and geoscientists. Bridging between subsurface and production, the handbook provides engineers and geoscientists with effective methodology to better define resources and reservoirs. Better reservoir knowledge and innovative technologies are making unconventional resources economically possible, and multidisciplinary approaches in evaluating these resources are critical to successful development. Unconventional Oil and Gas Resources Handbook takes this approach, covering a wide range of topics for developing these resources including exploration, evaluation, drilling, completion, and production. Topics include theory, methodology, and case histories and will help to improve the understanding,integrated evaluation, and effective development of unconventional resources. Presents methods for a full development cycle of unconventional resources, from exploration through production Explores multidisciplinary integrations for evaluation and development of unconventional resources and covers a broad range of reservoir characterization methods and development scenarios Delivers balanced information with multiple contributors from both academia and industry Provides case histories involving geological analysis, geomechanical analysis, reservoir modeling, hydraulic fracturing treatment, microseismic monitoring, well performance and refracturing for development of unconventional reservoirs

GeoProc2008 collects the proceedings of the International Conference on Coupled T-H-M-C (thermal, hydraulic, mechanical, chemical) Processes in Geosystems.

A comprehensive textbook presenting techniques for the analysis and characterization of shale plays Significant reserves of hydrocarbons cannot be extracted using conventional methods. Improvements in techniques such as horizontal drilling and hydraulic fracturing have increased access to unconventional hydrocarbon resources, ushering in the “shale boom” and disrupting the energy sector. Unconventional Hydrocarbon Resources: Techniques for Reservoir Engineering Analysis covers the geochemistry, petrophysics, geomechanics, and economics of unconventional shale oil plays. The text uses a step-by-step approach to demonstrate industry-standard workflows for calculating resource volume and optimizing the extraction process. Volume highlights include: Methods for rock and fluid characterization of unconventional shale plays A workflow for analyzing wells with stimulated reservoir volume regions An unconventional approach to understanding of fluid flow through porous media A comprehensive summary of discoveries of massive shale resources worldwide Data from Eagle Ford, Woodford, Wolfcamp, and The Bakken shale plays Examples, homework assignments, projects, and access to supplementary online resources Hands-on teaching materials for use in petroleum engineering software applications The American Geophysical Union promotes discovery in Earth and space science for the benefit of humanity. Its publications disseminate scientific knowledge and provide resources for researchers, students, and professionals.

The Middle and Upper Devonian Horn River Shale, comprising the Evie and Otter Park members and the Muskwa Formation, northeast British Columbia, Canada is recognized as a significant shale gas reservoir in the Western Canada Sedimentary Basin. However, many aspects of this shale formation have not been adequately studied, and the published geochemical, petrophysical and geomechanical data are limited. This work aims to document the controls of geochemical composition variation on petrophysical and geomechanical properties and the relationship of rock composition to lithofacies and stratigraphic sequences. A detailed core-based sedimentological and wireline log analysis was conducted by my colleague Dr. Korhan Ayranci as a parallel study, in order to classify lithofacies, interpret depositional environments and establish sequence stratigraphic framework across the basin. Major and trace elements concentrations, key trace element ratios and Corg-Fe-S relationships were used to understand the effect of sea level fluctuation on detrital flux, redox conditions, productivity and therefore organic carbon enrichment patterns. Detrital sediment flux indicated by the concentration of aluminum and titanium to the basin was found to be higher during transgressions than regressions. Redox conditions, exhibiting strong correlation to TOC content, were the primary controls on the organic carbon deposition. The bottom water conditions are more anoxic during transgressions than regressions. The presence of biogenic silica, identified by crossplot of silica versus zirconium concentrations, makes the use of total silica problematic as a detrital proxy; biogenic silica concentrations may be useful as a proxy for productivity. The depositional environments for the Evie and Muskwa intervals, depositing during high sea level, represented favorable conditions for organic matter accumulation, including anoxic bottom water conditions, high primary productivity and less clastic dilution. The Otter Park Member, deposited during sea level falling stage, has relatively low organic matter concentrations, which may have been due to high clastic dilution and dysoxic to oxic bottom water conditions. Geochemical controls on petrophysical properties (porosity, permeability, pore morphology, pore size and pore throat size distribution) within Horn River shale reservoirs were investigated by an integrated analysis of porosity and permeability measured by helium pynconometry and GRI method, nitrogen adsorption analysis, mercury injection analysis, scanning electron microscopy (SEM) and transmission electron

microscopy (TEM). Porosity ranges from 0.62% to 12.04%, and the measured matrix permeability values increase with increasing porosity, ranging between 1.7 and 42.8 nanodarcy. Among the organic matter and inorganic components, TOC content exerts the strongest control on porosity and permeability. Pore size and pore throat size distribution are strongly associated with TOC content, decreasing with increasing TOC content. SEM and TEM images suggest that several kinds of sites for porosity development are present, including organic matter, pyrite framboids, clay platelets, quartz rims, carbonate grains and microfractures. High porosity and permeability are associated with specific depositional facies. Massive and pyritic mudstones, which are rich in TOC and quartz, have relatively high porosity and permeability. Laminated mudstone, bioturbated mudstone and carbonate, which are rich in clay and carbonate content, have relatively low porosity and permeability. Rock mechanical properties were evaluated by hardness measurements and Young's modulus, Poisson's ratio and brittleness calculated from dipole sonic and density log data. Clay content is the most significant factor controlling the brittleness of shale rocks. The effect of quartz content on rock mechanical properties depends on the type of the quartz present in the rock. Authigenic quartz is positively correlated with brittleness, but detrital quartz has little or no effect. Factor analysis indicates that carbonate increases brittleness, while no obvious correlation between TOC content and brittleness was observed in this study. Brittleness in Horn River Shale shows both geographic and stratigraphic variability. Increasing brittleness in the northwest part of the basin largely results from greater distance from the sediment source and decreased clay content. The Otter Park member represents a period of major relative sea level fall and is more ductile than the underlying Evie Member and the overlying Muskwa Formation because of its high clay content.

Geomechanical processes occurring during steam assisted gravity drainage (SAGD) thermal recovery influence petrophysical and rock mechanical properties of both reservoir and caprock formations. While geostatistical techniques provide multiple equi probable geological realizations for petrophysical properties, rock mechanical properties are traditionally considered as homogenously in reservoir geomechanical simulations of the SAGD process. This research has shown that consideration of heterogeneous facies and rock mechanical properties will result in a larger range of possible outcomes, such as vertical displacement within the reservoir, than simulation models that adopt homogeneous facies and property distributions. Typically, only a select number of geological realizations are selected for simulation. Randomly selecting geological realizations will not accurately represent uncertainty and they should be selected based on appropriate ranking criteria. A ranking criterion, which is in good correlation with expected elastic deformation of reservoir, has been developed in this research. The developed ranking technique is based on expected elastic deformation of each cell considered in numerical simulation of SAGD. Geometrical calibration parameters are adopted within the developed ranking technique. Upscaling of geological models and moving from high resolution geological models to coarse scale simulation models results in reduction of number of cells and accordingly reduction of computational cost. A new numerical technique for upscaling of elastic properties has been proposed. Two major advantages of the new geomechanical upscaling technique include the ability to consider transversely isotropic deformation and independence from coarse scale properties with respect to facies configuration. The ranking and upscaling approaches were applied to a McMurray Formation field case study dataset. In comparison to upscaling techniques based on averaging, the numerical upscaling technique provided a reduction in simulation error. In addition, application of the upscaling technique to real field data confirmed the reduction in computational time for reservoir geomechanical simulations.

Praise for Reservoir Geomechanics: --

This thesis presents an important step towards a deeper understanding of naturally fractured carbonate reservoirs (NFCRs). It demonstrates

the various kinds of discontinuities using geological evidence, mathematical kinematics model and computed tomography and uses this as a basis for proposing a new classification for NFCRs. Additionally, this study takes advantage of rock mechanics theory to illustrate how natural fractures can collapse due to fluid flow and pressure changes in the fractured media. The explanations and mathematical modeling developed in this dissertation can be used as diagnostic tools to predict fluid velocity, fluid flow, tectonic fracture collapse, pressure behavior during reservoir depleting, considering stress-sensitive and non-stress-sensitive, with nonlinear terms in the diffusivity equation applied to NFCRs. Furthermore, the book presents the description of real reservoirs with their field data as the principal goal in the mathematical description of the realistic phenomenology of NFCRs.

Provides comprehensive information about the key exploration, development and optimization concepts required for gas shale reservoirs Includes statistics about gas shale resources and countries that have shale gas potential Addresses the challenges that oil and gas industries may confront for gas shale reservoir exploration and development Introduces petrophysical analysis, rock physics, geomechanics and passive seismic methods for gas shale plays Details shale gas environmental issues and challenges, economic consideration for gas shale reservoirs Includes case studies of major producing gas shale formations

Petrophysical Characterization and Fluids Transport in Unconventional Reservoirs presents a comprehensive look at these new methods and technologies for the petrophysical characterization of unconventional reservoirs, including recent theoretical advances and modeling on fluids transport in unconventional reservoirs. The book is a valuable tool for geoscientists and engineers working in academia and industry. Many novel technologies and approaches, including petrophysics, multi-scale modelling, rock reconstruction and upscaling approaches are discussed, along with the challenge of the development of unconventional reservoirs and the mechanism of multi-phase/multi-scale flow and transport in these structures. Includes both practical and theoretical research for the characterization of unconventional reservoirs Covers the basic approaches and mechanisms for enhanced recovery techniques in unconventional reservoirs Presents the latest research in the fluid transport processes in unconventional reservoirs

Geotechnical Aspects of Underground Construction in Soft Ground comprises a collection of 112 papers, four general reports on the symposium themes, the Fujita Lecture, three Special Lectures and the Bright Spark Lecture presented at the Tenth International Symposium on Geotechnical Aspects of Underground Construction in Soft Ground, held in Cambridge, United Kingdom, 27-29 June 2022. The symposium is the latest in a series which began in New Delhi in 1994, and was followed by symposia in London (1996), Tokyo (1999), Toulouse (2002), Amsterdam (2005), Shanghai (2008), Rome (2011), Seoul (2014) and Sao Paulo (2017). This was organised by the Geotechnical Research Group at the University of Cambridge, under the auspices of the Technical Committee TC204 of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE). Geotechnical Aspects of Underground Construction in Soft Ground includes contributions from more than 25 countries on research, design and construction of underground works in soft ground. The contributions cover: Field case studies Sensing technologies and monitoring for underground construction in soft ground Physical and numerical modelling of tunnels and deep excavations in soft ground Seismic response of underground infrastructure in soft ground Design and application of ground improvement for underground construction Ground movements, interaction with existing structures and mitigation measures The general reports give an overview of the papers submitted to the symposium, covered in four technical sessions. The proceedings include the written version of the five invited lectures covering topics ranging from developments in geotechnical aspects of underground construction, tunnelling and groundwater interaction (short and long-term effects), the influence of earth pressure balance shield

tunnelling on pre-convergence and segmental liner loading (field observations, modelling and implications on design). Similar to previous editions, Geotechnical Aspects of Underground Construction in Soft Ground represents a valuable source of reference on the current practice of analysis, design, and construction of tunnels and deep excavations in soft ground. The book is particularly aimed at academics and professionals interested in geotechnical and underground engineering.

A surge of interest in the geomechanical and petrophysical properties of mudrocks (shales) has taken place in recent years following the development of a shale gas industry in the United States and elsewhere, and with the prospect of similar developments in the UK. Also, these rocks are of particular importance in excavation and construction geotechnics and other rock engineering applications, such as underground natural gas storage, carbon dioxide disposal and radioactive waste storage. They may greatly influence the stability of natural and engineered slopes. Mudrocks, which make up almost three-quarters of all the sedimentary rocks on Earth, therefore impact on many areas of applied geoscience. This volume focuses on the mechanical behaviour and various physical properties of mudrocks. The 15 chapters are grouped into three themes: (i) physical properties such as porosity, permeability, fluid flow through cracks, strength and geotechnical behaviour; (ii) mineralogy and microstructure, which control geomechanical behaviour; and (iii) fracture, both in laboratory studies and in the field.

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Effective measurement of the composition and properties of petroleum is essential for its exploration, production, and refining; however, new technologies and methodologies are not adequately documented in much of the current literature. Analytical Methods in Petroleum Upstream Applications explores advances in the analytical methods and instrumentation that allow more accurate determination of the components, classes of compounds, properties, and features of petroleum and its fractions. Recognized experts explore a host of topics, including: A petroleum molecular composition continuity model as a context for other analytical measurements A modern modular sampling system for use in the lab or the process area to collect and control samples for subsequent analysis The importance of oil-in-water measurements and monitoring The chemical and physical properties of heavy oils, their fractions, and products from their upgrading Analytical measurements using gas chromatography and nuclear magnetic resonance (NMR) applications Asphaltene and heavy ends analysis Chemometrics and modeling approaches for understanding petroleum composition and properties to improve upstream, midstream, and downstream operations Due to the renaissance of gas and oil production in North America, interest has grown in analytical methods for a wide range of applications. The understanding provided in this text is designed to help chemists, geologists, and chemical and petroleum engineers make more accurate

estimates of the crude value to specific refinery configurations, providing insight into optimum development and extraction schemes.
Since the beginning of the US shale gas revolution in 2005, the development of unconventional oil and gas resources has gathered tremendous pace around the world. This book provides a comprehensive overview of the key geologic, geophysical, and engineering principles that govern the development of unconventional reservoirs. The book begins with a detailed characterization of unconventional reservoir rocks: their composition and microstructure, mechanical properties, and the processes controlling fault slip and fluid flow. A discussion of geomechanical principles follows, including the state of stress, pore pressure, and the importance of fractures and faults. After reviewing the fundamentals of horizontal drilling, multi-stage hydraulic fracturing, and stimulation of slip on pre-existing faults, the key factors impacting hydrocarbon production are explored. The final chapters cover environmental impacts and how to mitigate hazards associated with induced seismicity. This text provides an essential overview for students, researchers, and industry professionals interested in unconventional reservoirs.
Geomechanical and Petrophysical Properties of MudrocksGeological Society of London
Geological Carbon Storage Subsurface Seals and Caprock Integrity Seals and caprocks are an essential component of subsurface hydrogeological systems, guiding the movement and entrapment of hydrocarbon and other fluids. Geological Carbon Storage: Subsurface Seals and Caprock Integrity offers a survey of the wealth of recent scientific work on caprock integrity with a focus on the geological controls of permanent and safe carbon dioxide storage, and the commercial deployment of geological carbon storage. Volume highlights include: Low-permeability rock characterization from the pore scale to the core scale Flow and transport properties of low-permeability rocks Fundamentals of fracture generation, self-healing, and permeability Coupled geochemical, transport and geomechanical processes in caprock Analysis of caprock behavior from natural analogues Geochemical and geophysical monitoring techniques of caprock failure and integrity Potential environmental impacts of carbon dioxide migration on groundwater resources Carbon dioxide leakage mitigation and remediation techniques Geological Carbon Storage: Subsurface Seals and Caprock Integrity is an invaluable resource for geoscientists from academic and research institutions with interests in energy and environment-related problems, as well as professionals in the field.
This book offers a practical reference guide to soft rock mechanics for engineers and scientists. Written by recognized experts, it will benefit professionals, contractors, academics, researchers and students working on rock engineering projects in the fields of civil engineering, mining and construction engineering. Soft Rock Mechanics and Engineering covers a specific subject of great relevance in Rock Mechanics – and one that is directly connected to the design of geotechnical structures under difficult ground conditions. The book addresses practical issues related to the geomechanical properties of these types of rock masses and their characterization, while also discussing advances regarding in situ investigation, safety, and monitoring of geotechnical structures in soft rocks. Lastly, it presents important case histories involving tunnelling, dam foundations, coal and open pit mines and landslides.
CO2 capture and geological storage is seen as the most effective technology to rapidly reduce the emission of greenhouse gases into the atmosphere. Up until now and before proceeding to an industrial development of this technology, laboratory research has been conducted for several years and pilot projects have been launched. So far,

these studies have mainly focused on transport and geochemical issues and few studies have been dedicated to the geomechanical issues in CO2 storage facilities. The purpose of this book is to give an overview of the multiphysics processes occurring in CO2 storage facilities, with particular attention given to coupled geomechanical problems. The book is divided into three parts. The first part is dedicated to transport processes and focuses on the efficiency of the storage complex and the evaluation of possible leakage paths. The second part deals with issues related to reservoir injectivity and the presence of fractures and occurrence of damage. The final part of the book concerns the serviceability and ageing of the geomaterials whose poromechanical properties may be altered by contact with the injected reactive fluid.

From driverless cars to vehicular networks, recent technological advances are being employed to increase road safety and improve driver satisfaction. As with any newly developed technology, researchers must take care to address all concerns, limitations, and dangers before widespread public adoption. Transportation Systems and Engineering: Concepts, Methodologies, Tools, and Applications addresses current trends in transportation technologies, such as smart cars, green technologies, and infrastructure development. This multivolume book is a critical reference source for engineers, computer scientists, transportation authorities, students, and practitioners in the field of transportation systems management.

"Although carbonate reservoirs hold a wealth of hydrocarbon, they are among the most difficult types of reservoirs to be characterized. Carbonate reservoirs by nature have complex depositional environments and diagenetic processes in which brittle, ductile, fractured rocks, and vugular pores may all exist within small interval. This huge variance in the rock mechanical properties can cause challenges in the reservoir's development, especially in applications related to geomechanics. The main objective of this research is to geomechanically characterize and correlate the carbonate mechanical properties with their petrophysical properties. A comprehensive review for the geomechanical-petrophysical properties of carbonates was conducted from previous studies. Data from offset well have also been used to develop an integrated methodology that examines the uncertainty of carbonate wellbore integrity. The results present a new engineering classification to evaluate the carbonate drillability and deformability. Additional developments regarding the relationships between the carbonate compressive strength and confining pressure, maximum shear stress and mean stress, and internal friction angle and unconfined compressive strength (UCS) are systematically investigated based on the compiled database. New correlations to predict the UCS and Young's modulus of each carbonate type have been developed from the petrophysical properties. Applying P90 as a threshold on the estimated minimum mud weight proved to be conservative. For fracture mud weight, the field data showed that the P50 threshold did not prevent fluid losses.

This study contributes toward better methods to predict shear wave velocities exemplified with field cases in Southeast Iraq"--Abstract, page iv.