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A Practitioner’s Guide
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Enhanced Seismic Interpretation Using Well Logs and Vsp Data
Seismic Imaging of Carbonate Reservoirs and Systems

KEENAN KODY

A Practitioner’s Guide SEG Books
This book presents a comprehensive overview of relative fidelity preservation processing methods and their applications within the oil and gas sector. Four key principles for wide-frequency relative fidelity preservation processing are illustrated throughout the text. Seismic broadband acquisition is the basis for relative fidelity preservation processing and the influence of seismic acquisition on data processing is also analyzed. The methods and principles of Kirchhoff integral migration, one-way wave equation migration and reverse time migration are also introduced and illustrated clearly. Current research of relative amplitude preservation migration algorithms is introduced, and the corresponding numerical results are also shown. RTM (reverse time migration) imaging methods based on GPU/CPU systems for complicated structures are represented. This includes GPU/CPU high performance calculations and its application to seismic exploration, two-way wave extrapolation operator and boundary conditions, imaging conditions and low frequency noise attenuation, and GPU/CPU system based RTM imaging algorithms. Migration velocity model building methods in depth domain for complicated structures are illustrated in this book. The research status and development of velocity model building are introduced. And the impacting factors are also discussed. Several different velocity model building methods are also represented and analyzed. The book also provides the reader with several case studies of field seismic data imaging in different kinds of basins to show the methods used in practice.
Chapter 3. Fundamentals of Petroleum Geophysics John Wiley & Sons
Shows that developments in seismic interferometry - the methodology of

generating new seismic responses by crosscorrelation - have taken an enormous flight since the beginning of this century. In 2006, the editors of this volume compiled a supplement to Geophysics dedicated to this new branch of science. The 22 papers of the well-received supplement (recognized by one award for best paper and two honorable mentions for best paper in Geophysics and more than 100 citations in the first 20 months) form the basis for this reprint volume. The editors have added 50 papers from SEG and other journals, including Science, Physical Review, and Geophysical Research Letters. The book contains an editors' introduction with extensive references and chapters on seismic interferometry without equations, highlights of the history of seismic interferometry from 1968 until 2003, and a more detailed overview of the rapid developments since 2004. Seismic Interferometry is an invaluable source for researchers and students interested in the theory and applications of interferometry in geophysical exploration (seismic and EM), seismology, ultrasonics, and underwater acoustics.

Practical Applications of Time-lapse Seismic Data Springer

Published by the American Geophysical Union as part of the Geophysical Monograph Series, Volume 171. Groundwater is a critical resource and the PrinciPal source of drinking water for over 1.5 billion people. In 2001, the National Research Council cited as a "grand challenge" our need to understand the processes that control water movement in the subsurface. This volume faces that challenge in terms of data integration between complex, multi-scale hydrologie processes, and their links to other physical, chemical, and biological processes at multiple scales. Subsurface Hydrology: Data Integration for Properties and Processes presents the current state of the science in four aspects: Approaches to hydrologie data integration Data integration for characterization of hydrologie properties Data integration for understanding hydrologie processes Meta-analysis of current interpretations Scientists and researchers in the field, the laboratory, and the classroom will find this work an important resource in advancing our understanding of subsurface water movement.

Integration of Well Data Into Dynamic Reservoir Interpretation Using Multiple Seismic Surveys Elsevier

Useful attributes capture and quantify key components of the seismic amplitude and texture for subsequent integration with well log, microseismic, and production data through either interactive visualization or machine learning. Although both approaches can accelerate and facilitate the interpretation process, they can by no means replace the interpreter. Interpreter “grayware” includes the incorporation and validation of depositional, diagenetic, and tectonic deformation models, the integration of rock physics systematics, and the recognition of unanticipated opportunities and hazards. This book is written to accompany and complement the 2018 SEG Distinguished Instructor Short Course that provides a rapid overview of how 3D seismic attributes provide a framework for data integration over the life of the oil and gas field. Key concepts are illustrated by example, showing modern workflows based on interactive interpretation and display as well as those aided by machine learning.

Rock Quality, Seismic Velocity, Attenuation and Anisotropy Springer Nature

Quantitative Seismic Interpretation demonstrates how rock physics can be applied to predict reservoir parameters, such as lithologies and pore fluids, from seismically derived attributes. The authors provide an integrated methodology and practical tools for quantitative interpretation, uncertainty assessment, and characterization of subsurface reservoirs using well-log and seismic data. They illustrate the advantages of these new methodologies, while providing advice about limitations of the methods and traditional pitfalls. This book is aimed at graduate students, academics and industry professionals working in the areas of petroleum geoscience and exploration seismology. It will also interest environmental geophysicists seeking a quantitative subsurface characterization from shallow seismic data. The book includes problem sets and a case-study, for which seismic and well-log data, and Matlab codes are provided on a website (http://www.cambridge.org/9780521816014). These resources will allow readers to gain a hands-on understanding of the methodologies.

Seismic Petrophysics in Quantitative Interpretation SEG Books

This book is written for advanced earth science students, geologists, petroleum engineers and others who want to get quickly ‘up to speed’ on the interpretation of reflection seismic data. It is a development of material given to students on the MSc course in Petroleum Geology at Aberdeen University and takes the form of a course manual rather than a systematic textbook. It can be used as a self-contained course for individual study, or as the basis for a class programme. The book clarifies those aspects of the subject that students tend to find difficult, and provides insights through practical tutorials which aim to reinforce and deepen understanding of key topics and provide the reader with a measure of feedback on progress. Some tutorials may only involve drawing simple diagrams, but many are computer-aided (PC based) with graphics output to give insight into key steps in seismic data processing or into the seismic response of some common geological scenarios. Part I of the book covers basic ideas and it ends with two tutorials in 2-D structural interpretation. Part II concentrates on the current seismic reflection contribution to reservoir studies, based on 3-D data.

Seismic Interpretation and Reservoir Characterization of the Middle Eocene Gialo Formation, Assamoud Field, Sirte Basin, Libya Springer Science & Business Media

Modern introduction to seismic data processing demonstrating exploration and global geophysics applications through real data and tutorial examples that can be demonstrated with the instructor's software of choice. The underlying physics and mathematics of analysis methods is presented, showing students the limitations and potential for creating models of the sub-surface.

Seismic Data Analysis CRC Press

Studying the southern Indus Basin for oil and gas exploration has always been tough to interpret because of less Heave, Throw and a lot of mini structures. In 2008, Chiltan Formation (Jurassic age) in central Indus basin was hit for a gas. Yet it is being spared to find petroleum in southern part. At shot point 790 of one of seismic line, Formation showed promising structure at depth 3300m. MATLAB 3D surfaces of Rock physical parameters confirmed the Chiltan's potential. Alozai (Late Triassic) showed oil shows in history and therefore effort is being made to show its surface map pictures as well. This thesis will provide base for new explorers to distinguish the geology and geometrical structures of Chiltan and Alozai Formations in southern Indus basin. A foundation made available for companies that can be preceded for regional exploration. Top Lower Goru (Cretaceous) in central and lower Indus basin is producible for many years. However, experience of Mari Gas Company exploring TLG was bitter. Misinterpretation and wrong calculations lead failure of well. Petrophysical analysis, including composite logs and Moveable Hydrocarbon Index in this thesis, showed

postmortem of dry well.
A Petroleum Geologist's Guide to Seismic Reflection Cambridge University Press
Carbonate reservoir characterization introduce challenges that constantly require updates based on new seismic and production data. Understanding the connection between seismic response and litho-petrophysical properties is a crucial component to producing tangible results in hydrocarbon reservoir characterization, particularly in carbonate reservoirs. Applying models in seismic interpretation is essential to integrating data from a variety of disciplines including geology, geophysics, petrophysics and reservoir engineering. In this study, three post-stack seismic attributes (instantaneous bandwidth and peakedness along with volume attributes such as Root Mean Square - RMS energy) are used to distinguish and identify seismic classes pertaining to variations in litho/petrophysical facies from the Mississippian saline aquifer hosted in a carbonate reservoir from the Wellington Field, Sumner County, Kansas. Neutron porosity, bulk density, and sonic well logs provided a correlation with seismic amplitude, which in turn reflects reservoir properties associated to acoustic impedance. Neutron porosity logs were characterized into three classes. Class one representing a porosity less than eight percent, Class two representing a porosity class of greater than eight and less than twelve percent and Class three representing a porosity greater than twelve percent. The impedance differences across a seismic reflector are the controlling parameter of reflectivity. By having seismic and well log data sets provide the connection to characterize the reservoir to be modeled for porosity prediction based on amplitude and seismic facies classification for the effects of enhanced oil recovery (EOR) or geological sequestration of CO2. Using an unsupervised neural network and selecting three facies classes to correlate with three petrophysical classes. Three well-log classes are defined to describe the reservoir in terms of porosity using neutron porosity well logs. Seismic facies three has the highest porosity (greater than 12 percent), landed in structurally low areas and likely resemble dolomite prone area. The second-facies has porosity between 7 and 13 percent resemble a transitional zone from structurally low to high showing reworked brecciated limestone facies from CT scans. Seismic facies one has porosity less than 11 percent and resemble a structurally high erosional area. The seismic facies prediction map was constructed by correlating reservoir porosity using neutron porosity logs and seismic amplitude attributes in a carbonate reservoir. Due to the nature of elastic properties and mineralogy of carbonates that render the reservoir porosity the most significant factor controlling amplitude variation. Seismic amplitude attributes (bandwidth, peakedness, and RMS energy) reveal some unexpected features interpreted as small-scale faults associated with the Nemaha Uplift. Using the same three attributes as an input for an unsupervised neural network and selecting three seismic facies produces results that correlate with one out of the three porosities, providing a correlation between well-logs and seismic amplitude that can be used to predict reservoir facies in terms of porosity especially for higher porous zones. A CT scan of the top of Wellington KGS #1-32 core indicates slit-shaped (fracture) porosity and vuggy porosity dominate at the top of the reservoir. The bottom of the reservoir is dominated by fractured porosity ranging from 1.1 mm to 0.1 mm in size. The slit-shaped porosity is orientated vertically while the vuggy porosity was located within the diagenetic dolomite which was contained within the chert. Wellington KGS #2-32 core is dominated by slit-shaped porosity ranging in size from 0.4mm to 0.07mm. Slit shaped porosity shown from the middle CT scan in the Wellington KGS #2-32 shows faulting is associated after diagenesis of the dolomite. The vuggy porosity are the result from diagenetic processes and the slit-shaped porosity is associated to faulting from the Nemaha Uplift. This study illustrates the ability to use a data driven approach to an unsupervised neural network to identify seismic facies that relate to porosity classes by integrating well-logs, seismic attributes, and CT scans to characterize a carbonate petroleum reservoir system.
Interpretation of Three-Dimensional Seismic Data, Seventh Edition AAPG
This book is meant for geoscientists and engineers who are beginners, and introduces them to the field of seismic data interpretation and evaluation. The exquisite seismic illustrations and real case examples interspersed in the text help the readers appreciate the interpretation of seismic data in a simple way, and at the same time, emphasize the multidisciplinary, integrated practical approach to data evaluation. A concerted effort has been made for the readers to realize that mindless interpretation of seismic data using sophisticated software packages, without having a grasp on the elementary principles of geology and geophysics, and coupled with their over-reliance on workstations to provide solutions can have appalling results all too very often.
Reservoir Characterization Using Seismic Attributes, Well Data, and Artificial Neural Networks Cambridge University Press
This book introduces readers to the field of seismic data interpretation and evaluation, covering themes such as petroleum exploration and high resolution seismic data. It helps geoscientists and engineers who are practitioners in this area to both understand and to avoid the potential pitfalls of interpreting and evaluating such data, especially the over-reliance on sophisticated software packages and workstations alongside a lack of grasp on the elementary principles of geology and geophysics. Chapters elaborate on the necessary principles, from topics like seismic wave propagation and rock-fluid parameters to seismic modeling and inversions, explaining the need to understand geological implications. The difference between interpretation of data and its evaluation is highlighted and the author encourages imaginative, logical and practical application of knowledge. Readers will appreciate the exquisite illustrations included with the accessibly written text, which simplify the process of learning about interpretation of seismic data. This multidisciplinary, integrated and practical approach to data evaluation will prove to be a valuable tool for students and young professionals, especially those connected with oil companies.
The Science Behind Discovery Springer Nature
This book introduces readers to seismic inversion methods and their application to both synthetic and real seismic data sets. Seismic inversion methods are routinely used to estimate attributes like P-impedance, S-impedance, density, the ratio of P-wave and S-wave velocities and elastic impedances from seismic and well log data. These attributes help to understand lithology and fluid contents in the subsurface. There are several seismic inversion methods available, but their application and results differ considerably, which can lead to confusion. This book explains all popular inversion methods, discusses their mathematical backgrounds, and demonstrates their capacity to extract information from seismic reflection data. The types covered include model-based inversion, colored inversion, sparse spike inversion, band-limited inversion, simultaneous inversion, elastic impedance inversion and

geostatistical inversion, which includes single-attribute analysis, multi-attribute analysis, probabilistic neural networks and multi-layer feed-forward neural networks. In addition, the book describes local and global optimization methods and their application to seismic reflection data. Given its multidisciplinary, integrated and practical approach, the book offers a valuable tool for students and young professionals, especially those affiliated with oil companies.

Converted Wave Imaging in Anisotropic Media Using Sea-floor Seismic Data John Wiley & Sons

Seismic measurements take many forms, and appear to have a universal role in the Earth Sciences. They are the means for most easily and economically interpreting what lies beneath the visible surface. There are huge economic rewards and losses to be made when interpreting the shallow crust or subsurface more, or less accurately, as the case may be.

Seismic While Drilling SEG Books

"The Gialo Formation is a major gas producing reservoir in the Assamoud Field, Sirte Basin, Libya. It is called Gialo limestone because it consists of shallow marine limestone. Seismic and well data in conjunction with the results of a previous study were used to delineate the hydrocarbon reservoir of Middle Eocene Gialo Formation of Assamoud Field area located in Eastern part of concession 6, Sirte Basin, Libya. The data include three-dimensional seismic data acquired by Sirte Company in 2009. It covers approximately an area of 150 km2 and with more than 10 wells penetrating the reservoir. Seismic data were used to identify any structural and stratigraphic features such as faults and channels which may play important role in hydrocarbon traps. Seismic mapping of two way travel time for the top and the base of Gialo Formation indicates that the highest area in the Assamoud field is at 4840 ft subsea around wells H4-6, H5-6, H6-6, and H8-7 and the deepest point is at 4900 ft subsea. The well data were used to determine the average petrophysical characteristics of Assamoud field. The results indicate that the Middle Eocene Gialo reservoir is of good high quality with very good porosity reaching 23.9% at well H6-7. The correlation between wells using GR and SP logs indicates that the net thickness of the Gialo Formation ranges from 0 ft in well H2-6 to 220 ft in well H6-6. The gas water contact is at 4859 ft SS. The bulk volume was derived from net isopach map. The original gas in place and the recoverable gas were calculated volumetrically to be 889.23 Billion Standard Cubic Feet (BSCF) and 622.61 (BSCF) respectively. Analysis of seismic and well data demonstrates that the highest producing wells in the study area are those located at structural highs with an average porosity ranging from 20% to 24%"--Abstract, leaf iii.

AAPG Memoir 42, 7th Edition/SEG Investigation in Geophysics, No. 9 John Wiley & Sons

Seismic Data Analysis Techniques in Hydrocarbon Exploration explains the fundamental concepts and skills used to acquire seismic data in the oil industry and the step-by-step techniques necessary to extract the sections that trap hydrocarbons as well as seismic data interpretation skills. It enhances the ability to interpret seismic data and use that data for basin evaluation, structural modeling of a fault, reservoir characterization, rock physics analysis, field development, and production studies. Understanding and interpreting seismic data is critical to oil and gas exploration companies. Arming young geoscientists with a reference that covers the key principles of seismic data analysis will enhance their job knowledge, skills and performance. A fundamental grasp of seismic data enhances employability and aids scientists in functioning effectively when working with seismic data in industry. Edited by a team of petroleum geoscientists with more than 30 years of experience in hydrocarbon exploration and data analysis at O&G companies. More than 200 figures, photographs, and illustrations aid in the understanding of the fundamental concepts and techniques used to acquire seismic data Takes an easy-to-follow, step-by-step approach to presenting the techniques and skills used to extract the geologic sections from acquired seismic data. Enhances the geoscientist’s effectiveness when using seismic data for field development and other exploration and production studies

Relative Fidelity Processing of Seismic Data Elsevier Inc. Chapters

Seismic and Well Log Data Integration Using Data-matching Techniques

Seismic Data Interpretation using Digital Image Processing SEG Books

Öz Yilmaz has expanded his original volume on processing to include inversion and interpretation of seismic data. In addition to the developments in all aspects of conventional processing, this two-volume set represents a comprehensive and complete coverage of the modern trends in the seismic industry-from time to depth, from 3-D to 4-D, from 4-D to 4-C, and from isotropy to anisotropy.

Space, Structure and Randomness Seismic and Well Log Data Integration Using Data-matching TechniquesRelating well log data to seismic data is an important step in integrated reservoir characterization studies. Traditionally, an interpreter uses well log data, which has high vertical resolution but little lateral coverage, to understand amplitude variations in seismic data, which has lower vertical resolution than well logs but high spatial coverage. The process of calibration is referred to as a seismic-well tie. Several problems arise with the assumptions of conventional seismic-well tie workflows. The seismic-well tie involves generating a reflectivity series from available sonic and density logs acquired at the well, which inherently assumes all wells have a sonic and density log available along the entire length of the well. In many cases, this assumption is not valid as the number of wells drilled often out-numbers the number of sonic and density logs acquired. Common procedures to account for missing well logs in seismic-well ties are to use a time-depth relationship from a nearby well or use an empirical relationship to estimate the missing well log from an available well log. These methods provide constructive solutions. However, variations in structure, stratigraphy or missing/incomplete well logs can result in inaccurate seismic-well ties. In this thesis, I propose a method that predicts missing well log data by first estimating the shifts that align well logs with a reference type log. Once in this stratigraphically correlated, or `relative geologic time,' domain, I interpolate the missing well log data from available logs of the same type. The resulting well log is consistent with available well data and is not distorted by structural or stratigraphic variations. Once complete well log suites are estimated for each well, I focus on improving the efficiency and consistency of multiple seismic-well ties. The seismic-well tie typically involves a subjective and labor-intensive workflow that depends on the interpreter's experience and intuition. I introduce an automatic workflow using local similarity to match the synthetic with the real seismic trace. The advantage of using local similarity to compute the seismic-well tie is that consistent, repeatable, seismic-well ties are achieved. I generate a global log property volume by interpolating log data along local seismic structure and perform blind well tests to verify the accuracy and consistency of seismic-well ties. I apply this workflow to a 3D seismic dataset with 26 wells and achieve consistent, accurate and reproducible seismic-well ties. Combining the results of the well log interpolation and seismic-well tie I can generate a time-to-depth relationship for each well regardless

of the initial well log suite. As a result, it is possible to generate log property volumes that integrate the high spatial coverage of seismic data with information from well log data. Well log data can also provide a useful source of information during velocity model building for depth migration. Using concepts and workflows described previously, I show that the mis-tie between a modeled synthetic and real seismic trace is related to an inaccurate migration velocity. Furthermore, this information can be used to update the migration velocity model such that modeled synthetic seismograms, the seismic image, migration velocities and well log velocities become consistent.Reservoir Characterization Using Seismic Attributes, Well Data, and Artificial Neural NetworksSeismic Data Interpretation using Digital Image Processing
Hardcover plus DVD
History and Present Status SEG Books
Geophysical techniques apply the principles of physics for study of physical responses of rocks under passive or active perturbation. Geophysical data acquisition, processing and interpretation are driven by established scientific principles. Data from geophysical tools provide coverage with spatially continuous high density measurements. Well data like cores and well logs provide vertically high resolution measurements at the well location, however, the distribution of wells is sparse and discontinuous. The detailed spatial coverage from geophysical data are calibrated with analysis of well logs, pressure tests, cores, geologic depositional knowledge and other information from appraisal wells. The methods use high precision sensors that measure the properties on the earth's surface, in oceans, in wells and from the air, also from satellites. They measure changes of physical properties and calibrate the measured geophysical attributes with rock properties. The data play important role in developing a gross reservoir model. The reservoir architecture or structure and the reservoir rock and fluid properties are derived from the analysis and data integration. Other reservoir properties that can affect geophysical measurements are density, oil viscosity, stresses, and fractures. The interpretation has inherent ambiguity or multiple interpretations. Geophysics contributes to reservoir characterization, reservoir monitoring and its management by adding maximum value in improving production plan and by minimizing risk e.g., risk of dry hole, risk of blow out, risk of in-efficient recovery process, among others. Multiple geologic parameters are assessed with the same geophysical data.

Multiple Layer Surface Mapping with Seismic Data and Well Data Elsevier
The purpose of this book is to give a theoretical and practical introduction to seismic-while-drilling by using the drill-bit noise. This recent technology offers important products for geophysical control of drilling. It involves aspects typical of borehole seismics and of the drilling control surveying, hitherto the sole domain of mudlogging. For aspects related to the drill-bit source performance and borehole acoustics, the book attempts to provide a connection between experts working in geophysics and in drilling. There are different ways of thinking related to basic knowledge, operational procedures and precision in the observation of the physical quantities. The goal of the book is to help "build a bridge" between geophysicists involved in seismic while drilling - who may need to familiarize themselves with methods and procedures of drilling and drilling-rock mechanics - and drillers involved in geosteering and drilling of "smart wells" - who may have to familiarize themselves with seismic signals, wave resolution and radiation. For instance, an argument of common interest for drilling and seismic while drilling studies is the monitoring of the drill-string and bit vibrations. This volume contains a large number of real examples of SWD data analysis and applications.