Using Seismic And Well Data For While Drilling Litho

AAPG Memoir 42, 7th Edition/SEG Investigation in Geophysics, No. 9
Geostatistics for Seismic Data Integration in Earth Models
Seismic Data Analysis
Quantitative Reservoir Characterization Integrating Seismic Data and Geological Scenario Uncertainty
Geophysical Exploration Technology
History and Present Status
Integration of Well Data Into Dynamic Reservoir Interpretation Using Multiple Seismic Surveys
Methods and Applications
Enhanced Seismic Interpretation Using Well Logs and Vsp Data
Reservoir Characterization of the Kizler North Field, Lyon Co., Kansas, USA
Seismic Data Interpretation using Digital Image Processing
Interpretation of Three-Dimensional Seismic Data, Seventh Edition
Multiple Layer Surface Mapping with Seismic Data and Well Data

2003 Distinguished Instructor Short Course
Applications in Lithological and Stratigraphic Reservoirs
Applying Rock Physics Tools to Reduce Interpretation Risk
Quantitative Seismic Interpretation
Seismic Interpretation and Reservoir Characterization of the Middle Eocene Gialo Formation, Assamoud Field, Sirte Basin, Libya
Data Integration for Properties and Processes
Seismic Data Analysis Techniques in Hydrocarbon Exploration
Seismic Data Interpretation and Evaluation for Hydrocarbon Exploration and Production
Space, Structure and Randomness
Seismic Inversion Methods: A Practical Approach
Seismic and Well Log Data Integration Using Data-matching Techniques
Geophysical Work on Part of S. Indus Basin Using Seismic and Well Data
Practical Applications of Time-lapse Seismic Data
Carbonate Reservoir Characterization Based on Integration of 3-D Seismic Data and Well Logs Using Conventional and Artificial Intelligence Approaches
2013 Distinguished Instructor Short Course
Seismic-facies Classification and Reservoir Facies Mapping
Processing, Inversion, and Interpretation of Seismic Data

Seismic Petrophysics in Quantitative Interpretation
Rock Quality, Seismic Velocity, Attenuation and Anisotropy
Subsurface Hydrology
A Practitioner's Guide
Geophysics for Petroleum Engineers
Seismic Imaging of Carbonate Reservoirs and Systems
3D Velocity-depth Model Building Using Surface Seismic and Well Data
Integrated Analysis of Seismic Attributes and Well-logs in Reservoir Characterization
Seismic Interferometry
Seismic Data Interpretation and Evaluation for Hydrocarbon Exploration and Production

CHAMBERS VALERIE

AAPG Memoir 42, 7th Edition/SEG Investigation in Geophysics, No. 9 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.

Geostatistics for Seismic Data Integration in Earth Models Springer Science & Business Media

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.
Seismic Data Analysis SEG Books
Relating 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.
Quantitative Reservoir Characterization Integrating Seismic Data and Geological Scenario Uncertainty SEG Books
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.
Geophysical Exploration Technology SEG Books
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.
History and Present Status LAP Lambert Academic Publishing
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.
Integration of Well Data Into Dynamic Reservoir Interpretation Using Multiple Seismic Surveys John Wiley & Sons
The main objective of this dissertation is to characterize reservoir models quantitatively using seismic data and geological information. Its key contribution is to develop a practical workflow to integrate seismic data and geological scenario uncertainty. First, to address the uncertainty of multiple geological scenarios, we estimate the likelihood of all available scenarios using given seismic data. Starting with the

probability given by geologists, we can identify more likely scenarios and less likely ones by comparing the pattern similarity of seismic data. Then, we use these probabilities to sample the posterior PDF constrained in multiple geological scenarios. Identifying each geological scenario in metric space and estimating the probability of each scenario given particular data helps to quantify the geological scenario uncertainty. Secondly, combining multiple-points geostatistics and seismic data in Bayesian inversion, we have studied some geological scenarios and forward simulations for seismic data. Due to various practical issues such as the complexity of seismic data and the computational inefficiency, this is not yet well established, especially for actual 3-D field datasets. To go from generating thousands of prior models to sampling the posterior, a faster and more computationally efficient algorithm is necessary. Thus, this dissertation proposes a fast approximation algorithm for sampling the posterior distribution of the Earth models, while maintaining a range of uncertainty and practical applicability. Lastly, the proposed workflow has been applied in an actual reservoir. The field, still in the early stage, has limited well data, seismic data, and some geological observations. Accordingly, the proposed workflow can guide several processes, from selecting geological scenarios to suggesting a set of models for decision makers. The case study, applied in a turbidite reservoir in West Africa, demonstrates the quantitative seismic reservoir characterization constrained to geological scenarios. It contains a well log study, rock physics modeling, a forward simulation for generating seismic responses, and object-based prior modeling. As the result, we could pick some promising geological scenarios and its geological parameters from seismic data using distance-based pattern similarity. Next, based on the selected geological scenarios, Metropolis sampler using Adaptive Spatial Resampling (M-ASR) successfully sampled the posterior conditioned to all available data and geological scenario uncertainty.

Methods and Applications Elsevier

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.

Enhanced Seismic Interpretation Using Well Logs and Vsp Data

Elsevier Inc. Chapters

Authored by one of the world’s hydrocarbon exploration experts, Geophysical Exploration Technology: Applications in Lithological and Stratigraphic Reservoirs presents the latest technological advancements and cutting edge techniques in reservoir theory, research and exploration.

Stratigraphic and lithological reservoirs play a critical role in increasing the production from oil reserves and new hydrocarbon sources. Recent resource evaluations indicate that onshore stratigraphic and subtle reservoirs account for as much as 40% of the total remaining hydrocarbon sources globally. As a result, these reservoirs will be the most practical, potential and prevalent fields for long-lasting onshore exploration. Intended as an aid in developing an understanding of the techniques of reservoir exploration, this book presents the latest and most practical methods and technology in oil and gas exploration. It can be used as a training book for lithological stratigraphic exploration and a reference for scientific and technological personnel in the oil and gas industry. Authored by one of the world's foremost experts in stratigraphic and lithological reservoir exploration who has more than 30 years of experience in research and instruction. Features more than 200 figures, illustrations, and working examples to aid the reader in retaining key concepts Presents the latest technological developments in reservoir exploration techniques Integrates theory and application, arming readers with a rigorous yet practical approach to hydrocarbon exploration in stratigraphic and lithological reservoirs

Reservoir Characterization of the Kizler North Field, Lyon Co., Kansas, USA 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

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. Seismic Data Interpretation using Digital Image Processing John Wiley & Sons 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.

Interpretation of Three-Dimensional Seismic Data, Seventh Edition 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.

Multiple Layer Surface Mapping with Seismic Data and Well Data

John Wiley & Sons

Hardcover plus DVD

2003 Distinguished Instructor Short Course Springer Nature

Bridging the gap between modern image processing practices by the scientific community at large and the world of geology and reflection seismology This book covers the basics of seismic exploration, with a focus on image processing techniques as applied to seismic data. Discussions of theories, concepts, and algorithms are followed by synthetic and real data examples to provide the reader with a practical understanding of the image processing technique and to enable the reader to apply these techniques to seismic data. The book will also help readers interested in devising new algorithms, software and hardware for interpreting seismic data. Key Features: Provides an easy to understand overview of popular seismic processing and interpretation techniques from the point of view of a digital signal processor. Presents image processing concepts that may be readily applied directly to seismic data. Includes ready-to-run MATLAB algorithms for most of the techniques presented. The book includes essential research and teaching material for digital signal and image processing individuals interested in learning seismic data interpretation from the point of view of digital signal processing. It is an ideal resource for students, professors and working professionals who are interested in learning about the application of digital signal processing theory and algorithms to seismic data.

Applications in Lithological and Stratigraphic Reservoirs Springer

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.

Applying Rock Physics Tools to Reduce Interpretation Risk John Wiley & Sons

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.

Quantitative Seismic Interpretation 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 Interpretation and Reservoir Characterization of the Middle Eocene Gialo Formation, Assamoud Field, Sirte Basin, Libya

CRC Press

Time-lapse (4D) seismic technology is a key enabler for improved hydrocarbon recovery and more cost-effective field operations. Practical Applications of Time-lapse Seismic Data (SEG Distinguished Instructor Series No. 16) shows how 4D seismic data are used for reservoir surveillance, how they provide valuable insight on dynamic reservoir properties such as fluid saturation, pressure, and temperature, and how they add value to reservoir management. The material, based on the 2013 SEG Distinguished Instructor Short Course, includes discussions of reservoir-engineering concepts and rock physics critical to the understanding of 4D data, along with topics in 4D seismic acquisition and processing. A primary focus of the book is interpretation and data integration. Case-study examples are used to demonstrate key concepts and are drawn on to demonstrate the range of interpretation methods currently employed by industry and the diversity of geologic settings and production scenarios in which 4D is making a difference. Time-lapse seismic interpretation is inherently integrative, drawing on geophysical, geologic, and reservoir-engineering data and concepts. As a result, this book should be of interest to individuals from all subsurface disciplines.

Data Integration for Properties and Processes SEG Books

The aim of this work is to improve the practice of multicomponent data processing in the time domain. I present a detailed study carried out on a 2D multicomponent dataset acquired over the Lomond Field, North Sea. I show that this area is seismically anisotropic and that failure to account for the anisotropy leads to poor converted wave imaging results. Anisotropy is included in a complex model-building scheme prior to Pre-Stack Time Migration (PSTM). The basic parameters required in converted wave processing are the converted-wave stacking velocity based on non-hyperbolic moveout and different P-wave to S-wave velocity ratios. These parameters are extracted from analysis on asymptotically binned gathers, that is, gathers binned with a constant value of the velocity ratio vp/vs. I present results of a sensitivity analysis and I show that in areas affected by dip the stacking velocity is sensitive to changes in the initial vp/vs ratio. These small velocity errors are propagated as the square in the re-calculation of the depth-variant velocity ratio and cannot be ignored. I show that using imaging criteria to define the binning velocity ratio provides a valid and velocity-independent estimate in zones of complex geology. The vertical velocity ratio is derived conventionally by event matching in the P-wave and converted wave stacks. I present an attempt to use well-log derived velocity ratios to avoid this interpretative step. The velocity ratio derived from 4C seismic data is about 30% higher than that derived from well logs. I analyse three possible causes for this discrepancy: the effects of gas, polar anisotropy and frequency-dependent dispersion. Gas has little effect in the Lomond Field logs, while polar anisotropy lowers the well-log derived vp/vs ratio by about 15%. Frequency-dependent dispersion also lowers the well-log derived velocity ratio, but it is difficult to quantify. Residual errors in the seismic interpretation have also to be considered. Importantly, I prove that the ratio leading to the best image is the one derived from seismic data, which suggests that the use of the raw well-log derived velocity ratio in multicomponent processing should be avoided. I quantify anisotropy using an effective parameter, representing converted-wave anisotropy, ceff, which is a combination of P- and S-wave anisotropy. This parameter can be estimated from converted wave seismic data alone and I illustrate two different ways of extracting it. I present imaging results from a full anisotropic PSTM processing sequence. This flow requires careful model building and allows updating in the time-migrated domain. Comparing the values of the anisotropic parameter and of the binning velocity ratio before and after PSTM highlights the difference between the initial model and the updated model. Both parameters are in fact sensitive to the presence of dip. I show that the values of the anisotropic parameter change after PSTM, suggesting that part of the residual moveout attributed to anisotropy prior to PSTM was caused by dip. This consideration confirms the importance of defining the model in the time-migrated domain. The PSTM image matches with a high degree of accuracy the geological interpretation carried out by BG Group. PSTM tests show that the inclusion of anisotropy allows the use of the full range of offsets, which is important to produce the correct image of the target area. I compare this result with the image obtained from a flow based on isotropic Dip Moveout (DMO) and post stack migration. Differences in the position of the steep-dipping events and geological misties are evident in the post-stack migrated image. This mis-positioning is due to the isotropic approximation and to the limitation of the DMO and post-stack migration flow. I also present results of an integrated analysis of local geology, well logs and seismic data to confirm the presence of polar anisotropy in the Lomond Field. The sediments forming the overburden are mainly composed of finely laminated shales. The image I obtained from the full Pre-Stack Depth Migration on P-P data reveals a depth mismatch with the well markers. Since the pre-stack gathers show that the correct velocities are applied, this depth mismatch has to be attributed to the presence of anisotropy. Other clear evidences of anisotropy come from well logs. P-velocity angular dependency is evident in sonic logs. I show that a similar angular dependency also exists when comparing interval velocities and average velocities from seismic data and from vertical well logs and check shots. These considerations leave little doubt that the Lomond Field is seismically anisotropic.

Seismic Data Analysis Techniques in Hydrocarbon Exploration Elsevier

The Kizler North Field is near the western flank of the Forest City Basin in Lyon Co., Kansas, USA and produces oil from the Hunton Formation, Viola Formation and Simpson Group reservoirs. The structure strikes NW through the field that is part of a larger wrench fault system. This modern prospect analysis of the Kizler North Field, aids in understanding the reservoir properties of the Hunton Formation, Viola Formation and Simpson Group rocks, the play mechanism of the field, and provides recommendations for additional drilling locations. A detailed prospect evaluation using 2D seismic data and well log data from the Kizler North Field uses 1) Contour mapping of formations with public data from wells (~n=60), 2) Structural and stratigraphic analysis of 2D seismic data, and 3) Characterization of reservoir properties from well-log data from existing wells. Correlation of 2D seismic data with well data is used to visualize structures, to detect stratigraphic features, and to interpret seismic reflection patterns of the target horizons. The Viola Formation and Simpson Group production is located at the apex of the anticlinal structure. However, time structure, isopach and isochron maps show that the Hunton Formation is significantly thinned across the axis of the anticline owing to erosion. The thinning of Hunton Formation in the structural top is also observed in the nearby analog Kizler and John Creek fields. Five wrench faults are identified in the study area, which are present only in the pre-Mississippian Formations. Faults that do not extend far above the target formation are typically the best candidates because the faults have not breached the seal for the hydrocarbons. The trapping mechanism of this field is controlled by wrench faulting where traps are created by four-way closure at the apex of the anticline. Three potential drilling location are based on, 1) four-way closure with wrench fault trapping 2) structural highs in the Viola Formation and/or Simpson Group 3) Hunton Formation thickness 4) absence of fault beyond the reservoir formations.