Problems in Exploration Seismology and Their Solutions

Seismic Attributes for Prospect Identification and Reservoir Characterization

Seismic Data Analysis

Near-surface Geophysics

Fundamentals of Geophysical Interpretation

Illustrated Seismic Processing

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Seismic Data Analysis
professional geophysicists with many years' experience in the oil industry, the book is indispensable for geoscientists using 3-D seismic data, including graduate students and new entrants into the petroleum industry.

**Geophysical Signal Analysis**

Seismic interferometry is an exciting new field in geophysics utilizing multiple scattering events to provide unprecedented views of the Earth's subsurface. This is the first book to describe the theory and practice of seismic interferometry with an emphasis on applications in exploration seismology. Exercises are provided at the end of each chapter, and the text is supplemented by online MATLAB codes that illustrate important ideas and allow readers to generate synthetic traces and invert these to determine the Earth's reflectivity structure. Later chapters reinforce these principles by deriving the rigorous mathematics of seismic interferometry. Incorporating examples that apply interferometric imaging to synthetic and field data, from applied geophysics and earthquake seismology, this book is a valuable reference for academic researchers and oil industry professionals. It can also be used to teach a one-semester course for advanced students in geophysics and petroleum engineering.

**Practical Seismic Data Analysis**

This book discusses a number of subjects concerning seismic data acquisition and seismic data processing. The author explains how the description of multiple-coverage data, gathered for a 2-D seismic line, as a three-dimensional wavefield is of prime importance to a proper understanding of seismic data acquisition and intimately related seismic data processing problems.

**Hardrock Seismic Exploration**

This text, an introduction to geophysical signal analysis, is concerned with the construction, analysis, and interpretation of mathematical and statistical models. In general, it is intended to provide material of interest to upper undergraduate students in mathematics, science, and engineering. Much of this book requires only a knowledge of elementary algebra. However, at some points, a familiarity with elementary calculus and matrix algebra is needed. The practical use of the concepts and techniques developed is illustrated by numerous applications. Care has been taken to choose examples that are of interest to a variety of readers. Therefore, the book contains material of interest to both geophysicists and those engaged in digital signal analysis in disciplines other than geophysics. This book is a reprint of the 1980 Prentice-Hall volume of the same title.

**Acquisition and Processing of Marine Seismic Data**

The scope of engineering seismology includes geotechnical site investigations for buildings and engineering infrastructures, such as dams, levees, bridges, and tunnels, landslide and active-fault investigations, seismic microzonation, and geophysical investigations of historic buildings. These projects require multidisciplinary participation by the geologist, geophysicist, and geotechnical and earthquake engineers. A key objective of this book (SEG Investigations in Geophysics Series No. 17) by Öz Yilmaz is to encourage the specialists from these disciplines to apply the seismic method to solve the many challenging engineering problems they face. The broader scope of engineering seismology also includes exploration of earth resources, including groundwater exploration, coal and mineral exploration, and geothermal exploration. While focusing on the application of the seismic method to geotechnical site investigations, this book includes many case studies in all of the applications of engineering seismology.

**Advanced Digital Signal Processing of Seismic Data**

**Seismic Interferometry**

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.

**Illustrated Seismic Processing, Volume 2: Preimaging**

**3-D Seismic Interpretation**

Covers the basic ideas and methods used in seismic processing, concentrating on the fundamentals of seismic imaging and deconvolution. Many of the seismic methods in popular use today go back to the work of some of the great scientists of past centuries. The ideas are developed from the ground up. Most chapters in the book are followed by problem sets. Some exercises are designed to supplement the material presented in the text; others are meant to stimulate classroom discussions. There are few industrial-grade illustrations. Instead, both the text and the exercises deal mostly with simple examples that often can be solved with nothing more than a pencil and paper. Each chapter is as self-contained as possible to make it easier for a reader to concentrate on topics of particular interest. The book covers such basic topics as wave motion; digital imaging; digital filtering; various visualization aspects of the seismic reflection method; sampling theory; the frequency spectrum; synthetic seismograms; wavelets and wavelet processing; deconvolution; the need for continuing interaction between the seismic interpreter and the computer; seismic attributes; phase rotation; and seismic attenuation. The last of the 15 chapters gives a detailed mathematical overview. Digital Imaging and Deconvolution, nominated for the Association of Earth Science Editors award for the best geoscience publication of 2006-2009, will be of interest to professional geophysicists as well as graduate students and upper-level undergraduates in geophysics. The book also will be helpful to scientists and engineers in other disciplines who use digital signal processing to analyze and image wave-motion data in remote-detection applications. In particular, the methods described in this book are important in optical imaging, video imaging, medical and biological imaging, acoustical analysis, radar, and sonar.

**Exploration Geophysics**

**Seismic Data Processing with Seismic Un*x**

**Seismic Wavefield Sampling**

This book can be used as a primer to Seismic Un*x by those who may or may not already be familiar with seismic processing using other software packages. Two real data sets - including one from a deepwater survey - are provided on accompanying CD-ROMs. Seismic Un*x is available online from the Center for Wave Phenomena at Colorado School of Mines.

**Seismic Data Processing**

Seismic attributes play a key role in exploration and exploitation of hydrocarbons. In Seismic Attributes for Prospect Identification and Reservoir Characterization (SEG Geophysical Developments No. 11), Satinder Chopra and Kurt J. Marfurt introduce the physical basis, mathematical implementation, and geologic expression of modern volumetric attributes including coherence, azimuth, curvature, amplitude gradients, seismic textures, and spectral
decomposition. The authors demonstrate the importance of effective color display and sensitivity to seismic acquisition and processing. Examples from different basins illustrate the attribute expression of tectonic deformation, elastic depositional systems, carbonate depositional systems and diagenesis, drilling hazards, and reservoir characterization. The book is illustrated generously with color figures throughout. "Seismic Attributes" will appeal to seismic interpreters who want to extract more information from data; seismic processors and imagers who want to learn how their efforts impact subtle stratigraphic and fracture plays; sedimentologists, stratigraphers, and structural geologists who use large 3D seismic volumes to interpret their plays within a regional, basinwide context; and reservoir engineers whose work is based on detailed 3D reservoir models. Copublished with EAGE.

**Machine Learning in the Oil and Gas Industry**

This modern introduction to seismic data processing in both exploration and global geophysics demonstrates practical applications through real data and tutorial examples. The underlying physics and mathematics of the various seismic analysis methods are presented, giving students an appreciation of their limitations and potential for creating models of the subsurface. Designed for a one-semester course, this textbook discusses key techniques within the context of the world's ever increasing need for petroleum and mineral resources - equipping upper undergraduate and graduate students with the tools they need for a career in industry. Examples presented throughout the text allow students to compare different methods and can be demonstrated using the instructor's software of choice. Exercises at the end of sections enable students to check their understanding and put the theory into practice and are complemented by solutions for instructors and additional case study examples online to complete the learning package.

**Processing of Seismic Reflection Data Using MATLAB**

**A Handbook for Seismic Data Acquisition in Exploration**

**Data Analytics for Drilling Engineering**

Elements of 3D Seismology, third edition is a thorough introduction to the acquisition, processing, and interpretation of 3D seismic data. This third edition is a major update of the second edition. Sections dealing with interpretation have been greatly revised in accordance with improved understanding and availability of data and software. Practice exercises have been added, as well as a 3D seismic survey predesign exercise. Discussions include: conceptual and historical foundations of modern reflection seismology; an overview of seismic wave phenomena in acoustic, elastic, and porous media; acquisition principles for land and marine seismic surveys; methods used to create 2D and 3D seismic images from field data; concepts of dip moveout, prestack migration, and depth migration; concepts and limitations of 3D seismic interpretation for structure, stratigraphy, and rock property estimation; and the interpretation role of attributes, impedance estimation, and AVO. This book is intended as a general text on reflection seismology, including wave propagation, data acquisition, processing, and interpretation and will be of interest to entry-level geophysicists, experts in related fields (geology, petroleum engineering), and experienced geophysicists in one subfield wishing to learn about another (e.g., interpreters wanting to learn about seismic waves or data acquisition).

**Seismic Data Processing**

**Seismic Petrophysics in Quantitative Interpretation**

Seismic imaging methods are currently used to produce images of the Earth's subsurface properties at diverse length scales, from high-resolution, near-surface environmental studies for oil and gas exploration to long-period images of the entire planet. This book presents the physical and mathematical basis of imaging algorithms in the context of controlled-source reflection seismology. The approach taken is motivated by physical optics and theoretical seismology. The theory is constantly put into practice via a graded sequence of computer exercises using the widely available SU (Seismic Unix) software package.

**Fundamentals of Geophysical Data Processing**

**Seismic Data Analysis**

This short book is for students, professors and professionals interested in signal processing of seismic data using MATLAB. The step-by-step demo of the full reflection seismic data processing workflow using a complete real seismic data set places itself as a very useful feature of the book. This is especially true when students are performing their projects, and when professors and researchers are testing their new developed algorithms in MATLAB for processing seismic data. The book provides the basic seismic and signal processing theory required for each chapter. It shows how to process the data from raw field records to a final image of the subsurface all using MATLAB. Table of Contents: Seismic Data Processing: A Quick Overview / Examination of A Real Seismic Data Set / Quality Control of Real Seismic Data / Seismic Noise Attenuation / Seismic Deconvolution / Carrying the Processing Forward / Static Corrections / Seismic Migration / Concluding Remarks

**Land Seismic Case Studies for Near-Surface Modeling and Subsurface Imaging**

A practical handbook for the petroleum geophysicist. Fundamental concepts are explained using heuristic descriptions of seismic modeling, deconvolution, depth migration, and tomography. Pitfalls in processing and contouring are described briefly. Applications include petroleum exploration of carbonate reefs, salt intrusions, and overthrust faults. The book includes past, present, and possible future developments in time-lapse seismology, borehole geophysics, multicomponent seismology, and integrated reservoir characterization.

**Encyclopedia of Solid Earth Geophysics**

Elementary, conceptual, and easy to read, this book describes the methods and techniques used to estimate rock properties from seismic data, based on a sound understanding of the elastic properties of materials and rocks and how the amplitudes of seismic reflections change with those properties. By examining the recorded seismic amplitudes in some detail, we can deduce properties beyond the basic geological structure of the subsurface. We can, using AVO and other amplitude techniques, characterize rocks and the reservoirs inside them with some degree of qualitative, and even quantitative, detail. Mathematics is not ignored, but is kept to a minimum. Intended for geophysicists, seismic acquisition specialists, processors, and interpreters, even those with little previous exposure to ‘quantitative interpretation’, ‘interpretive processing’ or ‘advanced seismic analysis’, this book also would be appropriate for geologists, engineers, and technicians who are familiar with the concepts but need a methodical review as well as managers and businesspeople who would like to obtain an understanding of these concepts.

**3-D Seismic Exploration**

This book presents the signal processing and data mining challenges encountered in drilling engineering, and describes the methods used to overcome them. In drilling engineering, many signal processing technologies are required to solve practical problems, such as downhole information transmission, spatial attitude of drilling, drillstring dynamics, seismic activity while drilling, among others. This title attempts to bridge the gap between the signal processing and data mining and oil and gas drilling engineering communities. There is an urgent need to summarize signal processing and data mining issues in drilling engineering so that practitioners in these fields can understand each other in order to enhance oil and gas drilling functions. In summary, this book shows the
importance of signal processing and data mining to researchers and professional drilling engineers and open up a new area of application for signal processing and data mining scientists.

**Theory of Seismic Imaging**

Acquisition and Processing of Marine Seismic Data demonstrates the main principles, required equipment, and suitable selection of parameters in 2D/3D marine seismic data acquisition, as well as theoretical principles of 2D marine seismic data processing and their practical implications. Featuring detailed datasets and examples, the book helps to relate theoretical background to real seismic data. This reference also contains important QC analysis methods and results both for data acquisition and marine seismic data processing. Acquisition and Processing of Marine Seismic Data is a valuable tool for researchers and students in geophysics, marine seismics, and seismic data, as well as for oil and gas exploration. Contains simple step-by-step diagrams of the methodology used in the processing of seismic data to demonstrate the theory behind the applications Combines theory and practice, including extensive noise, QC, and velocity analyses, as well as examples for beginners in the seismic operations market Includes simple illustrations to provide to the audience an easy understanding of the theoretical background Contains enhanced field data examples and applications

**Digital Imaging and Deconvolution**

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.

**Multiple Attenuation**

Extracting information from seismic data requires knowledge of seismic wave propagation and reflection. The commonly used method involves solving linearly for a reflectivity at every point within the Earth, but this book follows an alternative approach which invokes inverse scattering theory. By developing the theory of seismic imaging from basic principles, the authors relate the different models of seismic propagation, reflection and imaging - thus providing links to reflectivity-based imaging on the one hand and to nonlinear seismic inversion on the other. The comprehensive and physically complete linear imaging foundation developed presents new results at the leading edge of seismic processing for target location and identification. This book serves as a fundamental guide to seismic imaging principles and algorithms and their foundation in inverse scattering theory, and is a valuable resource for working geoscientists, scientific programmers and theoretical physicists.

**Seismic Imaging and Inversion: Volume 1**

Recognizing the need for education and further research in AVO, the editors have compiled an all-encompassing treatment of this versatile technology. In addition to providing a general introduction to the subject and a review of the current state of the art, this unique volume provides useful reference materials and data plus original contributions at the leading edge of AVO technologies.

**Elements of 3D Seismology, third edition**

**Engineering Seismology with Applications to Geotechnical Engineering**

Many text books have been written on the subject “Exploration Geophysics”. The majority of these texts focus on the theory and the mathematical treatment of the subject matter but lack treatment of practical aspects of geophysical exploration. This text is written in simple English to explain the physical meaning of jargon, or terms used in the industry. It describes how seismic data is acquired in 2-D and 3-D, how they are processed to convert the raw data to seismic vertical and horizontal cross sections, that are geologically meaningful, and how these and other data are interpreted to delineate a prospect. Workshops are included after each chapter and are designed to reinforce learning of the concepts presented. Key Features: Written in simple easy to understand language Heavily illustrated to aid in understanding the text End of chapter “Key words and workshop” The text includes several appendices and answers for the selected workshop problems

**Understanding Amplitudes**

**Offset-dependent Reflectivity**

The past few decades have witnessed the growth of the Earth Sciences in the pursuit of knowledge and understanding of the planet that we live on. This development addresses the challenging endeavor to enrich human lives with the bounties of Nature as well as to preserve the planet for the generations to come. Solid Earth Geophysics aspires to define and quantify the internal structure and processes of the Earth in terms of the principles of physics and forms the intrinsic framework which other allied disciplines utilize for more specific investigations. This text is written in simple English to explain the physical meaning of jargon, or terms used in the industry. It describes how seismic data is acquired in 2-D and 3-D, how they are processed to convert the raw data to seismic vertical and horizontal cross sections, that are geologically meaningful, and how these and other data are interpreted to delineate a prospect. Workshops are included after each chapter and are designed to reinforce learning of the concepts presented. Key Features: Written in simple easy to understand language Heavily illustrated to aid in understanding the text End of chapter “Key words and workshop” The text includes several appendices and answers for the selected workshop problems

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