Acquisition and Processing of Marine Seismic Data

Derman Dondurur

Demonstrates the main principles, equipment, and suitable selection of parameters as well as quality control (QC) analyses in 2D and 3D marine seismic data acquisition and processing.

 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

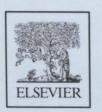
• Includes simple illustrations to provide to the audience an easy understanding of the theoretical background

· Contains enhanced field data examples and applications

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 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 involved in geophysics, marine seismic surveys, seismic data analysis, and oil and gas exploration.

Derman Dondurur is a research professor at the Institute of Marine Sciences and Technology at Dokuz Eylül University, Turkey. He has been working in single and multichannel seismic data acquisition for more than 15 years onboard the research vessel RV K. *Piri Reis*, where he leads the collection and processing of marine seismic data, QC processes, and parameter determination and testing applications during the acquisition and processing. He was the coordinator of several research and investigation projects, both scientific and private, working with private oil companies and research institutions, which included offshore seismic data acquisition and processing applications, for several years.





1. Introduction

- 1.1 Underwater Acoustics 7
- 1.2 Marine Acoustic Methods 9
- 1.3 Fundamentals of Marine Seismics 25

2. Marine Seismic Data Acquisition

- 2.1 Components of Marine Seismic Acquisition 40
- 2.2 Air Gun Arrays 62
- 2.3 3D Marine Seismic Acquisition 81
- 2.4 Specific Acquisition Techniques 100
- 2.5 Data Acquisition Parameters 112
- 2.6 QC in Data Acquisition 131

3. Noise in Marine Seismics

- 3.1 Operational Noise 174
- 3.2 Bubble Effect of the Air Gun 175
- 3.3 Multiple Reflections 177
- 3.4 Swell Noise 180
- 3.5 Bird Noise 183
- 3.6 Inline Waves 185
- 3.7 Diffractions 193
- 3.8 Guided Waves 193
- 3.9 Seismic Interference 196
- 3.10 Other Noise Types 200

4. Fundamentals of Data Processing

- 4.1 Autocorrelation 213
- 4.2 Crosscorrelation 215
- 4.3 Convolution 215
- 4.4 Fourier Series 216
- 4.5 1D Fourier Transform 219
- 4.6 2D Fourier Transform 222
- 4.7 z Transform 230
- 4.8 Hilbert Transform 231
- 4.9 τ-p Transform (Slant Stack) 232
- 4.10 Sampling Theory 235

5. Preprocessing

- 5.1 Demultiplexing 242
- 5.2 Data Loading 243
- 5.3 Single Trace Section 244
- 5.4 Geometry Definition 246
- 5.5 Band-Pass Filter 253
- 5.6 Gain Recovery 272
- 5.7 Trace Edit 287
- 5.8 Muting 294
- 5.9 f-k Dip Filters 299
- 5.10 Brute Stack 310

6. Deconvolution

- 6.1 Convolutional Model 316
- 6.2 Assumptions for Deconvolution 319
- 6.3 Spiking Deconvolution 324
- 6.4 Predictive Deconvolution 335
- 6.5 Determination of Deconvolution Parameters 337
- 6.6 Poststack Deconvolution 349
- 6.7 Maximum Entropy (Burg) Deconvolution 349
- 6.8 Shaping Filters 350
- 6.9 Surface Consistent Deconvolution 356
- 6.10 QC in Deconvolution 357

7. Suppression of Multiple Reflections

- 7.1 CDP Stack 368
- 7.2 Predictive Deconvolution 372
- 7.3 Deconvolution in τ-p Domain 382
- 7.4 Radon Velocity Filter 383
- 7.5 Wave Equation Multiple Rejection 388
- 7.6 f-k Filtering 391
- 7.7 Surface-Related Multiple Elimination 394
- 7.8 QC in Multiple Suppression 400

8. CDP Sort and Binning

- 8.1 CDP Geometry 405
- 8.2 CDP Fold 409
- 8.3 Binning in 3D 411
- 8.4 QC in Sort and Binning 415

9. Velocity Analysis	11.5 Reverse Time Migration 516
 9.1 Types of Seismic Velocity 424 9.2 Velocity Determination From Seismic Data 426 9.3 Velocity Analysis in Practice 436 9.4 QC in Velocity Analysis 453 	11.6 Poststack Migration 519 11.7 Prestack Migration 521 11.8 Depth Migration 524 11.9 3D Migration 526 11.10 Dip Moveout 529
10. Normal Moveout Correction and Stacking	11.11 Which Migration to Use? 532 11.12 QC in Migration 535
 10.1 Normal Moveout Time 461 10.2 NMO Stretching 469 10.3 Stacking 472 10.4 Specific Stacking Methods 475 10.5 QC in NMO Correction and Stacking 486 	12. Specific Methods 12.1 f-x Prediction Filter (f-x Decon) 549 12.2 Median Filter 553 12.3 Trace Mixing 556
11. Seismic Migration	12.4 Time-Variant Spectral Whitening 55 12.5 Instantaneous Attributes 562
11.1 Migration Concept 494	12.6 Amplitude vs. Offset 567
11.2 Kirchhoff Migration 502 11.3 Finite-Difference Migration 508	References 585
11.4 Frequency-Wavenumber (f-k) Migration 512	Index 589