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**Theory and Practice of
Geophysical Data Inversion**

Theory and Practice of Applied Geophysics

Edited by Andreas Vogel

Volume 1

Andreas Vogel (Ed.)

Model Optimization in Exploration Geophysics

Volume 2

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Model Optimization in Exploration Geophysics 2

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Geophysical Data Inversion

Methods and Applications

Volume 5

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Foreword

The contributions to this volume cover a wide spectrum of recent developments in geophysical data inversion, including basic mathematics and general theory, numerical methods, as well as computer implementation of algorithms.

Most of the papers are motivated by problems arising from geophysical research and applications both on a global scale and with respect to local geophysical surveys, underlining the increasing importance of geophysical exploration methods in various fields, such as structural geology, prospecting for mineral and energy resources, hydrogeology, geotechnology, environmental protection and archaeology.

The first section of the book deals with basic mathematics and general theory underlying geophysical data inversion. Papers presented here are concerned with stabilization algorithms to solve ill-posed inverse problems, sensitivity of kernel function estimations to random data errors and reduction of errors in inverse modelling of response functions by linear constraints, numerical procedures for approximating the solution to boundary value problems, accuracy and stability of inverse ill-posed problems constituted by problems of moments, and fast Fourier transforms for solving potential field problems.

The second section contains papers on gravity and magnetics, dealing with the solvability of the inverse gravimetric problem for sources represented by point masses and other elementary, solution of the inverse problem in cases of nonuniformly distributed data as obtained by palaeomagnetic studies, satellite observations, and surface projections of buried archaeological targets by inverse filtering of geomagnetic data.

Section three contains two papers on the inversion of electrical and electromagnetic data, concerned with the improvement of the resolution of model parameters by joint inversion of magnetotelluric and transient electromagnetic data as well as apparent complex resistivity data from dipoles energized over a wide range of transmitter frequencies.

Section four comprises a number of contributions on several aspects of seismic data inversion, including papers on the improvements of the efficiency in the reconstruction of acoustical impedance profiles by inversion of reflection seismograms, imaging of the subsurface velocity structures by inversion of seismic crosshole data, solution of the inverse seismic problem in cases of undersampled and noisy data, treatment of ill-posedness by regularization methods in cases of seismic modelling and inversion by integral equation methods, recursive inversion procedures for determination of seismic reflection coefficients, an optimization approach to the solution for the geometrical and mechanical parameters of earthquake sources, and spectral analysis for determination of the characteristics of seismic wave radiation from large explosions.

The paper of Section five is on geothermics, being concerned with the determination of subsurface temperature fields by inversion of geothermal data, thus allowing the reconstruction of past climates.

The monograph concludes with two papers on constraining conditions for joint inversion of gravity and seismic data.

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Berlin, Fall 1991

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