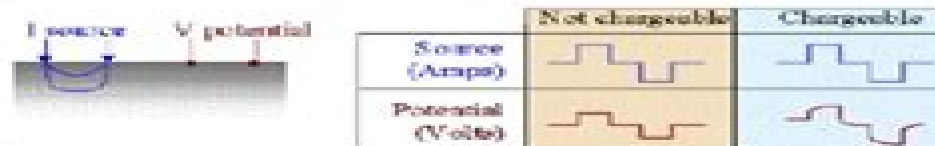


Descriptive outline

This module provides background about chargeability, and induced polarization surveying. There are no details about interpretation, inversion, or case histories - these will be added in a subsequent version of the module.

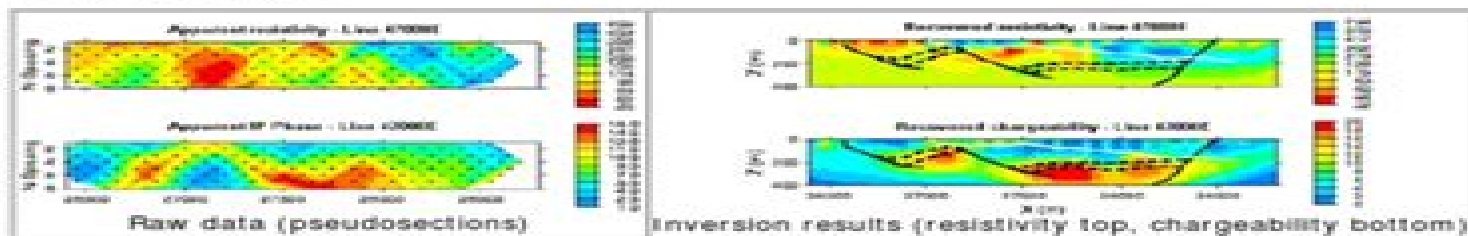
Chargeability is a physical property that is related to resistivity. The module about DC resistivity shows that potentials measured in a DC resistivity survey can be related to charges that accumulate when current is made to flow. However, when the transmitter current is switched off, the measured voltage may take up to several seconds to reach zero. Similarly, when the current is switched on, there may be a finite time taken for the voltage to reach a steady state value. In other words, current injected into the ground causes some materials to become polarized. The phenomenon is called induced polarization, and the physical property that is measured is usually called chargeability, which quantifies the material's capacity to retain charges after a forcing current is removed. The following figure illustrates the measurable effect.



Induced polarization can also be measured using low frequency sinusoidal signals, as discussed in the "Measurements and data" section of this chapter. The signals or data that are measured depend upon which of the various types of source signals are used. Note that IP surveys always include resistivity measurements because the potentials used to obtain apparent resistivity are required to calculate chargeability.

Examples

The data sets shown (below-left) were gathered simultaneously at the Century Deposit in Australia. Clearly they are exhibiting responses to different materials within the ground. However, this presentation of the raw data (plots called pseudosections) is deceptive, and does not represent true distribution of material properties in the ground. After inverting these data, the resulting resistivity model reveals information about rocks overlying the deposit, while the resulting chargeability model shows the deposit itself and underlying shale units.



The physical property - chargeability

The materials that are most chargeable include sulfide minerals (both massive and disseminated), clay-rich materials, and graphite. However, many chargeable materials have physical property values that range from nil to large even within the same region. This is because chargeability depends upon many factors, including mineral type, grain size, the ratio of internal surface area to volume, the properties of electrolytes in pore space, and the physics of interaction between surfaces and fluids.

Interpretation of chargeability models is further complicated by the fact that there is no standard set of units for this physical property. There are at least three ways of measuring the phenomenon and models recovered by inversion generally take on the same units as the measurement. This could be milli-seconds if measurements are made of the ground's response to impulsive sources. The units could also be percent if the response at two or more source signal frequencies is compared, or units of milliradians may be used if the phase difference between source and received signals is recorded.

Introduction To Induced Polarization Surveying

Muhammad Abdul Quddus



Introduction To Induced Polarization Surveying:

U.S. Geological Survey Professional Paper, 1979 *Geological Survey Professional Paper*, 1949 *Electromagnetic Coupling with a Collinear Array on a Two-layer Anisotropic Earth* Jeffrey C. Wynn, 1979 *Applied Geophysics* W. M. Telford, L. P. Geldart, R. E. Sheriff, 1990-10-26 This is the completely revised and updated version of the popular and highly regarded textbook *Applied Geophysics* It describes the physical methods involved in exploration for hydrocarbons and minerals which include gravity magnetic seismic electrical electromagnetic radioactivity and well logging methods All aspects of these methods are described including basic theory field equipment techniques of data acquisition data processing and interpretation with the objective of locating commercial deposits of minerals oil and gas and determining their extent In the fourteen years or so since the first edition of *Applied Geophysics* many changes have taken place in this field mainly as the result of new techniques better instrumentation and increased use of computers in the field and in the interpretation of data The authors describe these changes in considerable detail including improved methods of solving the inverse problem specialized seismic methods magnetotellurics as a practical exploration method time domain electromagnetic methods increased use of gamma ray spectrometers and improved well logging methods and interpretation **Petroleum Science and Technology** Muhammad Abdul Quddus, 2021-03-30 *Petroleum Science and Technology Petroleum Generation Accumulation and Prospecting* describes natural hydrocarbon geology along with applicable aspects of physics chemistry biology environmental science mathematics and engineering technology It starts off with a brief coverage of the origin and evolution of the universe petroleum origin and generation in subsurface condition source rock oil gas migration path and reservoir rock Geological geophysical and geochemical petroleum surveys are also included This book covers both theory and applied information Aimed at graduate students researchers and professionals in petroleum engineering and chemical engineering it Covers petroleum geology and technology including petroleum generation migration and reservoir formation Introduces the nature and formation of petroleum and its exploration Describes oil gas prospecting using geophysical chemical methods under subsurface condition Includes a detailed geochemical survey along with an analysis of kerogen and bitumen Explains petroleum migration and accumulation using two dimensional graphs MA Quddus PhD has served in the petroleum sector and R D organization both national and multinational for more than 40 years and has worked in various capacities including in the laboratory office field and plant and has also engaged in teaching petroleum technology as a visiting professor for 17 years He earned BSc Hons and MSc degrees along with a PhD with thesis titled *Oxidation of Asphalt* As a result of his constant research he has published nine international and 12 national papers obtained one patent presented five papers in conferences and prepared six technical reports He has also visited the USA Canada and Indonesia for short courses in petroleum technology and teacher training *Ontario Geological Survey Miscellaneous Paper*, 1976 *Guidebook to the Geology of Four Tertiary Volcanic Centers in Central Nevada* Frank R. Morrissey, Freeman Beach

Leighton, Geological Society of America. Cordilleran Section, James Irwin Gimlett, John Harold Schilling, N. L. Archbold, Richard L. Naff, George Burke Maxey, Larry J. Garside, Robert F. Kaufmann, 1968 *Basic Exploration Geophysics* Edwin S. Robinson, Cahit Coruh, 1988-07-28 Introduces geophysical methods used to explore for natural resources and to survey earth structure for purposes of geological and engineering knowledge These methods include seismic refraction and reflection surveying gravity and magnetic field surveying electrical resistivity and electromagnetic field surveying and geophysical well logging Covers modern field procedures and instruments as well as data processing and interpretation techniques including graphical methods All basic surveying methods are described step by step and illustrated by practical examples Well illustrated *Miscellaneous Paper - Ontario Geological Survey* Ontario Geological Survey, 1986

Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems, 1988 *Quarterly Bulletin of the Canadian Mining Institute* Canadian Institute of Mining and Metallurgy, Canadian Mining Institute, 1968 *CIM Bulletin* Canadian Institute of Mining and Metallurgy, Canadian Institute of Mining, Metallurgy and Petroleum, 1989 **Borehole Geophysics for Mining and Geotechnical Applications** Geological Survey of Canada, 1986 Proceedings of an International Symposium and Workshop on Borehole Geophysics for Mining and Geotechnical Applications held in Toronto in August 1983 The contents include 41 papers and summaries of two afternoon workshops on instrumentation and on interpretation and are arranged in order of presentation in groups of papers on logging applications calibration aspects EM methods applied potential methods acoustic methods magnetic borehole radar magnetometric resistivity gravity x ray and other nuclear methods The five papers from the earlier 1981 Geological Survey of Canada Mineral Logging Workshop concern inverse filtering of gamma ray logs borehole IP EM resistivity and seismic measurements and log calibration and quality control *Quarterly Bulletin of the Canadian Mining Institute* Canadian Institute of Mining, Metallurgy and Petroleum, Canadian Institute of Mining and Metallurgy, 1968 **Exploration Geophysics**, 2005 *Economic Geology, Seventy-fifth Anniversary Volume, 1905-1980* Brian J. Skinner, 1981 The papers that make up this volume are grouped under three general headings Geology of major classes of mineral deposits Application of geology geophysics and geochemistry to mineral exploration and Economic and social factors that affect exploration and development of mineral deposits The papers on geology are arranged generally so as to emphasize changes in the nature and type of mineral deposits through geologic time **Some Guides to Mineral Exploration** Ann P. Sabina, B. V. Sanford, Harington Molesworth Anthony Rice, K. E. Eade, R. A. Washington, Walter Andrew Bell, Willy Dyck, Geological Survey of Canada, R. H. C. Holman, 1966 **Geological and Geophysical Investigations of the Good Hope Mining District, Elko County, Nevada** Richard Dwayne Knox, 1970 *Principles of Induced Polarization for Geophysical Exploration* J.S. Sumner, 2012-12-02 Developments in Economic Geology 5 Principles of Induced Polarization for Geophysical Exploration focuses on the principles methodologies and approaches involved in induced polarization IP including anisotropism

electromagnetic coupling and electrical circuits The book first takes a look at resistivity principles theory of IP and laboratory work in IP Concerns cover electrical measurements of rocks anisotropism early part of decay curve and the comparison with frequency effects electrical models of induced polarization electrical polarization resistivities of earth materials and resistivity exploration methods The manuscript then elaborates on IP field equipment telluric noise and electromagnetic coupling IP field surveying and drill hole and underground surveying and the negative IP effect Discussions focus on differences between surface and subsurface methods current sending system in the field telluric earth currents electromagnetic coupling design considerations coupling of electrical circuits design considerations and signal generating system The manuscript ponders on the complex resistivity method and interpretation of induced polarization data including grade estimation of mineralization using the IP method complex resistivity survey signal detection capabilities of the complex resistivity method and disadvantages of the complex resistivity method The text is a valuable source of information for researchers wanting to study induced polarization

Transactions Canadian Institute of Mining and Metallurgy, 1898 Vols for 1918 include the Transactions of the Mining Society of Nova Scotia

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