

Book Review

3D Geoscience Modeling, Computer Techniques for Geological Characterization

By Simon W. Houlding

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The proposed audience of this slim information packed book includes professionals and students of the geosciences with an interest in geological modeling. This book is focused on the three-dimensional modeling of geological examples derived from well and mine data. The focus of these models is the management of waste site characterization, contaminant assessment, ground water flow simulation, mineral source evaluation, reservoir engineering, and tunnel design. Geologists who study hydrology, environmental engineering, and geotechnical problems associated with mining and water management rather than hydrocarbon exploration will find this book is aimed at them. On the other hand if you are expecting a volume which deals with new wave 3-D seismic interpretation, then this may not be the book for you, though it does consider geological databases derived from a variety of sources (including seismic) and how this information can be displayed in a 3-D format.

The book describes how to generate computer models which will enable geologists to extend geological interpretations and add geostatistical predictions and graphical visualization to what may already be limited databases.

The author cautions the reader that the various techniques described in this text are not necessarily new in themselves, but what is new is their tie to the developing discipline of 3-D visualization so an enhancement of risk assessment and a reduction of uncertainty. Simon Houlding warns his readers that geoscience modeling, because of the inadequate databases it is based on, is pushing the envelope. He fears that as tools for visualization become more sophisticated we will lose sight of the fact that the data we use to build these slick models is incomplete. We'll accept them as the truth rather than as beautiful concepts that have yet to be proved. Roger McBryde Allen expresses the same fear in his book, *The Shattered Sphere*, "Conventional Science becomes decadent when it relies too much on thought experiments, and the present-day multimode simulations are really nothing more than hugely elaborate thought experiments. We ask what

would happen if, rather than what is really happening. Every working scientist has experienced at least occasional difficulty in distinguishing between simulation and reality. It is far from rare for the researcher to discover that reality does not behave as predicted in the model and then proceed with a new experiment to show why reality was in error. We start to worry about building the perfect model, the perfect simulation, rather than dealing with the imperfections of the theories that produce the model.”

The book is divided into a section that deals with computer techniques for geological characterization and a section that looks at applications on the geosciences.

The first part of the book consists of ten chapters which focus on various forms of risk analysis and how geological data can be displayed in three dimensions using statistical approaches. The author provides the tools for building these three-dimensional models. Topics covered include such things as: how one can characterize geological variables; and what factors are complicated and have to be handled through computerization. This latter includes such topics as geological complexity, variety, the effect of time, and the measurement of uncertainty. Also discussed are how special data are managed and the various tools that can be used to visualize three-dimensional relationships, particularly to conduct statistical analysis. Data types and structure are considered, including how to categorize and organize this information and display this in map and volume form, and how these types of data interface with one another. This section also considers such things as spatial variability and how geological processes may affect the various trends and relationships seen in 3-D; relationships between geological interpretation and modeling; the development of interactive geological interpretations; and the use of 2-D and 3-D geological volumes. The section considers how to manipulate and model geological surfaces with a heavy emphasis on geostatistical prediction techniques including point kriging in a three-dimensional grid and problems related to cross checking of prediction results and the spatial predictions. There is also a chapter on spatial analysis techniques and one on uncertainty sampling control on risk assessment.

The final portion of the book deals with direct applications of 3-D modeling in the geosciences. Five examples are provided: one dealing with subsurface contamination; another dealing with hazardous waste characterization and underground repository design; the third deals with ore deposit evaluation associated with underground mine planning; the fourth deals with the characterization and the development of planning for a small oil reservoir; and the fifth example considers the characterization of an underground powerhouse excavation. The final chapter looks at new directions for the spatial prediction of modeling, database management and the use of GIS.

The book is packed with beautiful examples that include clear color and many black and white diagrams; all of these often showing three-dimensional

relationships. The use of real-world examples is not restricted to the latter part of the book and these are scattered through the introductory chapters, introducing the reader to the complexity of modeling three-dimensional geological relationships and providing an understanding of the use of geostatistics to help improve prediction through visualization techniques. This book avoids the use of mathematical equations to explain the various geological relationships discussed in this book, and instead uses diagrams and narrative to explain the approaches used in 3-D geoscience modeling. The text is definitely aimed at both the novice and the experienced professional, alerting the reader to techniques and methodology that can be used to solve the geological problems that they face. This is a very practical book aimed at educating readers rather than talking down to them or pretending that statistics are the answer to everything. The writer recognizes pitfalls of the techniques presented to the reader explaining that these are powerful tools for displaying geological information, but that these tools can be flawed and should be used with caution and understanding. The author recognizes that while an answer is demanded of the model, that model in itself may be flawed, and thus needs to be explained to those who examine the model after its creation. The book is loaded with numerous references and has a very fine bibliography which will help the reader entering this topic for the first time. The book reads well and is easy to understand. The emphasis on the use of color illustrations has improved the book and made it the great source of information that it is. If you're interested in computer modeling then this is a text that could be of great assistance to you. It provides techniques and methodology that you can use to predict the occurrence of many geological characteristics. A great book and a great buy.

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