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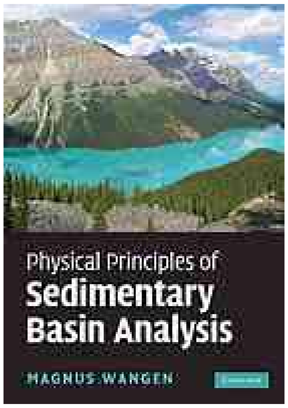

Physical Principles of Sedimentary Basin Analyses, Magnus Wangen, 2010, Cambridge University Press, 527 p., USD 140.00, ISBN: 978-0521761253

Physical Principles of Sedimentary Basin Analyses is a well-written book and a must-read for geoscientists and engineers interested in modeling geological processes. Graduate students, experienced researchers, and experts in the field of geomodeling in the oil and gas industry should recognize this book to be an invaluable resource. This book, however, requires prior knowledge of advanced mathematics and physics to follow the content and fully grasp the concepts presented.

This book describes and explains sedimentary basin processes from the perspective of a physicist using state-of-the-art physical modeling equation and concepts. Each of the 15 well-structured chapters is clearly illustrated with text, figures, exercises, and equations and concludes with a brief paragraph for further and more in-depth reading. Unlike many geology textbooks, this book starts with basic physical principles of rock properties and deformation building to basin analyses. The content flows very well from the first to the last chapter and can be subdivided into three sections. Section 1 (chapters 2–4) introduces basic principles of petrophysics and continuum mechanics. This is required background knowledge to follow the content subsequent chapters. Section 2 (chapters 5–10) focuses on basin formation and evolution; and section 3 (chapters 11–15) addresses more specific pore pressure and fluid flow related topics.

Chapter 1 is a preamble and briefly states notation standards used within this book. Chapter 2 introduces basic concepts of compaction, Fourier's law of heat transfer and a lengthy discussion of permeability as a tensor. Chapter 3 examines how porous media (rock) deforms through vertical and nonvertical stress and its relationship to effective stress and pore pressure evolution. Chapter 4 concludes section 1 with a brief discussion on the compressibility of rocks, essentially integrating chapters 2 and 3.

Section 2 covers processes focusing on the formation and evolution of basins rather than rock properties and starts with Chapter 5 explaining burial history as a method of basin analysis. Chapter 6 provides an in-depth review of heat origin and temperature dissemination within sedimentary basins, lithosphere, and mantle. Simple and advanced multidimensional conductive temperature equations, the origin of heat, methods to calibrate basin models (using "EASY%RO" as a temperature proxy), convective temperature terms for porous and fractured media (i.e., sedimentary rocks), and the mantle are discussed. Chapter 7 relates basin subsidence to lithospheric thinning and discusses standard concepts of isostasy and the McKenzie model, including complex cases such as finite duration or depth dependent thinning. This chapter closes with a case study of the Vøring basin, offshore Norway. Chapter 8 addresses deformation and flow of lithospheric and mantle rocks as functions of temperature and stress evolution and prepares the reader for a discussion on the flexure of the lithosphere in chapter 9. Section 2 closes with chapter 10 on the magnetic and gravitational field of the Earth and its application toward analyzing and modeling sedimentary basins.

The third section of this book addresses processes within basins and detailed examinations of pore pressure evolution and fluid flow. A brief discussion on quartz cementation processes in sandstones as a result of the effective stress and temperature history is provided in chapter 11. This chapter includes not only basics processes (P/T dependent quartz kinetics and precipitation) but also a model for quartz diffusion, which can be used in reactive transport modeling. Chapter 12 discusses the generation of overpressure with a rigorous physical formulation and includes comments on the overpressure effective stress relationship and hydrofracturing.

The following chapters (13 and 14) summarize, integrate, and restate previously introduced concepts about fluid flow and pore pressure in sedimentary basins. Topics include fluid flow equations derived from basic principles such as mass conservation of solids and fluids and water table potentials. Also discussed are details such as overpressure-induced stress, overpressure build-up in low permeability porous media such as clays, and time dependency to return to a normal pressured state. Chapter 14 closes with several select topics influencing a pressure solution. Noteworthy is that these chapters cover fluid flow in general and do not discuss multiphase (water, vapor, and liquid) fluid flow. The book ends with a brief chapter on the influence of production and injection wells on fluid flow and pore pressure.

In summary, *Physical Principles of Sedimentary Basin Analyses* is much overdue, an excellent book that approaches the field of modeling geological processes of sedimentary basins from a rigorous quantitative perspective. This book, however, is not a typical geological textbook and not useful for everybody. The number and complexity of equations clearly directs this book toward readers with applied mathematics and physics skills. They will find this book very useful for their studies or as a reference book. Only a few related subjects are missing from an otherwise complete review of sedimentary basin analysis: a dedicated discussion of basin-forming mechanisms due to strike slip deformation, a review of modeling the pressure centroid concept, guidance about how to use pressure data to calibrate basin models, and last, but not least, a solution to every exercise. Nevertheless, this book is a great read with plentiful of principles and concepts for quantitative basin modeling.

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