Carbonate Reservoirs: Porosity and Diagenesis in a Sequence Stratigraphic Framework

Carbonate Sands are very common and abundant in clastic sequences. They profoundly influence the quality of hydrocarbon reservoirs and supply important information on palaeoenvironments and the chemical composition and flow patterns of fluids in sedimentary basins. Despite this importance, their distribution patterns in time and space and their geochemical evolution are not yet deeply explored and elucidated. This Special Publication contains 21 review papers and case studies on carbonate cementation in clastic sequences written by invited specialists on the subject. These papers present a wide and deep coverage that enhance our knowledge about carbonate cementation in various clastic depositional environments, tectonic settings and burial histories. The book will be of special interest to researchers, petroleum geologists and teachers and students at the postgraduate level.

Carbonate Sands, a Core Workshop This book presents the proceedings of the 4th International Conference on Integrated Petroleum Engineering and Geosciences 2016 (ICipeg 2016), held under the banner of World Engineering, Science & Technology Congress (ESTCON 2016) at Kuala Lumpur Convention Centre from August 15 to 17, 2016. It presents peer-reviewed research articles on exploration, while also exploring a new area: shale research. In this time of low oil prices, it highlights findings to maintain the exchange of knowledge between researchers, serving as a vital bridge-builder between engineers, geoscientists, academics, and industry.

Effects of Porosity Type, Pore Geometry, and Diagenetic History on Tertiary Recovery of Petroleum from Carbonate Reservoirs Although carbonates make up only 20% of the sedimentary rock record, they account for more than 50% of the world's proven oil reserves. Carbonates differ from siliclastics in generation, geomorphology, and diagenesis, all of which modify the mineralogy, porosity, and permeability so important to reservoir quality and 3-D seismic response. The first eight chapters establish the geologic framework and consist of state-of-the-art review papers written by recognized experts in carbonate generation, rock properties, sequence stratigraphy, seismic stratigraphy, and structural deformation. The last 10 chapters illustrate the seismic expression of carbonate terranes through carefully chosen case studies drawn from the United States, Venezuela, Norway, China, Saudi Arabia, Italy, and the Bahamas, augmented by two careful studies of seismic signal-to-noise problems specific to carbonates. A recurring theme in each of these case studies is the importance of integrating seismic and petrophysical control with geologic models to better predict carbonate facies quality and distribution. This book is destined to become a well-worn reference volume that
sits easily within reach of every geologist, geophysicist, and engineer involved in the exploration or exploitation of carbonate reservoirs.

Military Construction Appropriations for 1966 The three diagenetic realms in which porosity modifications (e.g., dissolution, cementation, compaction) take place are the marine, meteoric, and subsurface environments. The meteoric environment—with its dilute waters, easy access to CO2, and wide range of saturation states with respect to carbonate phases—has high potential for porosity modification, including destruction by cementation and generation of secondary porosity by dissolution. Modern shallow-marine environments are particularly susceptible to porosity destruction by cementation due to high levels of supersaturation of marine waters relative to metastable carbonate minerals. Decreasing saturation with depth can lead to development of secondary porosity by dissolution of aragonite. In the geologic past, shallow-marine waters were often undersaturated with respect to aragonite. The subsurface environment is marked by loss of porosity through compaction and related cementation. Thermal maturation and degradation of hydrocarbons and the slow flux of basinal fluids during progressive burial drive later porosity modification by cementation and modest local dissolution. Recognition and differentiation of the porosity modification history of carbonate rocks is aided by a number of analytical tools. Petrography enables us to reconstruct the sequence of relatively timed diagenetic events responsible for porosity modifications. Trace element and stable isotope analyses of cements and dolomites provide insight into the types of waters involved in these events. Two-phase fluid inclusions are used to estimate temperatures of cement or dolomite formation and the composition of precipitating or dolomitizing fluids. The definitiveness of trace element analysis is often limited by uncertainties in distribution coefficients, temperature fractionation effects, or low concentration values. Two-phase fluid inclusion studies also pose significant problems (e.g., stretching of inclusions during burial, recognition of primary inclusions, and accuracy of pressure corrections). Therefore, these tools should be used to provide constraints on assessing environments of diagenetic events, within an appropriate petrographic/geologic framework. The continuing development of new instruments and techniques (e.g., the ion probe, clumped isotope analysis) holds great promise for the future of geochemical analyses in diagenetic studies.

Carbonate Diagenesis and Porosity Major porosity-modifying processes operating in the marine diagenetic realm are (1) cementation in shallow warm waters, (2) dolomitization accompanied by minor porosity enhancement in deep waters below the aragonite and calcite lysoclines, and (3) dolomitization associated with organic degradation during early burial. In shallow, normal marine environments, porosity is lost through abiotic and microbially mediated cementation. Such cementation is most abundant in shelf-margin reefs, high-energy intertidal zones, and isolated hardgrounds. Abiotic and microbial cementation in reefs—in combination with bioerosion and internal sedimentation—can totally destroy high initial reef framework porosities. Although intertidal and hardground cements tend to be vertically and laterally restricted, these zones can act as permeability barriers in reservoirs. Deep marine slope and basin environments can experience significant porosity modification. Aragonite cementation on the upper slope extends to 60m depth at present. During the Paleozoic and Mesozoic eras, carbonate mud mounds developed on upper shelf slopes and distal ramps. Microbial processes in these mounds contributed to both early cementation and dissolution. Many such mounds formed in conjunction with hydrothermal and cold petroleum vents on the seafloor; some of these mud mounds are significant reservoirs. Where the thermocline and carbonate lysoclines impinge on steep carbonate platform margins that front oceanic basins, dissolution of aragonite and/or calcite, precipitation of radiaxial calcite cement, and dolomitization can occur. Kohout thermal convection and mixing-zone-induced seawater circulation are the most likely hydrologic pumps driving large volumes of marine water through steep platform margins. At relatively shallow depths in the sediment/rock column, decomposition of organic matter mediated by sulfate-reducing bacteria can promote dissolution of aragonite and Mg-calcite, calcite cementation, and massive dolomitization.

Carbonate Reservoirs Over the years, many papers on carbonate diagenesis have been published in Sedimentology, the journal of the International Association of Sedimentologists. This volume
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presents a collection of these papers with a commentary. The emphasis of the book is on the
diagenesis of shallow-marine carbonate sediments and the editors have chosen 12 papers which are
reproduced in full. To widen the scope of this volume the abstracts for another 16 papers are
presented. These provide further examples of diagenetic studies and help to extend the coverage of
the book. The reprints and abstracts are divided into three groups, dealing with marine, meteoric
and burial diagenesis respectively. Each collection is preceded by a commentary which briefly
summarizes the topic and introduces the reprints and abstracts to come

Carbonate Reservoir Characterization Reservoir quality is studied using a wide range of similar
techniques in both sandstones and carbonates. Sandstone and carbonate reservoir quality both
benefit from the study of modern analogues and experiments, but modelling approaches are
currently quite different for these two types of reservoirs. There are many common controls on
sandstone and carbonate reservoir quality, but also distinct differences due primarily to mineralogy.
Numerous controversies remain including the question of oil inhibition, the key control on pressure
solution and geochemical flux of material to or from reservoirs. This collection of papers contains
case-study-based examples of sandstone and carbonate reservoir quality prediction as well as
modern analogue, outcrop analogue, modelling and advanced analytical approaches.

Carbonate Seismology Three economically important case histories serve as illustrations of the
integration of analyses of depositional environments, sequence stratigraphic architecture, and
porosity evolution during diagenesis, as a means of maximizing effectiveness of reservoir production
and/or modelling: (1) the Paleozoic Madison Formation of central Wyoming, (2) the Upper Jurassic
Smackover Formation of the central Gulf of Mexico, and (3) the Tertiary Malampaya buildup, offshore
Philippines. The three embody a broad range of geologic contexts (e.g., icehouse versus greenhouse
during deposition) and different approaches for optimizing development programs (e.g., use of
surface analogs, 3D seismically based reservoir modelling). High drilling costs during development of
the deep (23,000ft.) Madden Field in the Wyoming Madison Formation (due to high temperature,
pressure, and H2S content of the gas) mandated high efficiency during development. Meticulous
evaluation of a surface outcrop analog and maximized collection of analog data were the primary
means of assuring optimal reservoir development. The Upper Jurassic Smackover trend in the central
Gulf of Mexico illustrates revitalization of a mature petroleum fairway through application of
sequence stratigraphic interpretation. Previously overlooked lowstand siliciclastic slope fans become
geographically and stratigraphically predictable reservoir targets when understood in their proper
sequence stratigraphic framework. The 3D seismic grid over the drowned isolated
Oligocene–Miocene Malampaya platform, offshore Philippines, is integrated with geologic and
petrophysical data from sparse well control and field-wide depositional and diagenetic models in
order to develop a reservoir simulation model of the reservoir.

Geology of Carbonate Reservoirs This book integrates those critical geologic aspects of reservoir
formation and occurrence with engineering aspects of reservoirs, and presents a comprehensive
treatment of the geometry, porosity and permeability evolution, and producing characteristics of
carbonate reservoirs. The three major themes discussed are: • the geometry of carbonate reservoirs
and relationship to original depositional facies distributions • the origin and types of porosity and
permeability systems in carbonate reservoirs and their relationship to post-depositional diagenesis •
the relationship between depositional and diagenetic facies and producing characteristics of
carbonate reservoirs, and the synergistic geologic-engineering approach to the exploitation of
carbonate reservoirs. The intention of the volume is to fully acquaint professional petroleum
geologists and engineers with an integrated geologic and engineering approach to the subject. As
such, it presents a unique critical appraisal of the complex parameters that affect the recovery of
hydrocarbon resources from carbonate rocks. The book may also be used as a text in petroleum
geology and engineering courses at the advanced undergraduate and graduate levels.

Carbonate Reservoir Characterization: A Geologic-Engineering Analysis The porosity of carbonates as
compared to sandstones is vastly more complex with simple intergrain porosity dominates
sandstones while carbonates commonly exhibit complex secondary pore systems that may evolve
during burial. Initial porosity of carbonates is much greater than that seen in sandstones due to common intragranular porosity. Fractures, both natural and induced, are much more important in carbonates. Diagenesis is a major factor in the development of ultimate pore systems in carbonates. The geologically based Choquette–Pray carbonate porosity classification is the most commonly used scheme. Their 15 different pore types are based on fabric selectivity. A major feature of the classification is its recognition of the potential of porosity evolution through time and burial. Three porosity development zones are recognized: eogenetic, dealing with surface processes; mesogenetic, dealing with burial processes; and telogenetic, exhumed rocks dealing again with surface processes. This classification is best used during exploration, while other engineering-based classifications such as the one developed by Lucia should be used in reservoir characterization and as input for reservoir modeling. Examples of all 15 pore types are given.

Carbonate Cementation in Sandstones Two marine evaporative settings are presented in detail: the sabkha and the evaporative lagoon/salina. In each, diagenetic pathways affect porosity evolution in associated marine carbonate sequences, with common dolomitization being a principal factor. Dolomitization is favored where hypersaline waters possess high Mg/Ca ratios (postprecipitation of Ca-bearing evaporites) and potential for hydrologic drive (high fluid densities). Surficial dolomites in modern environments are poorly ordered “protodolomites”. Modern marginal marine sabkha diagenetic environments are thin (}

Advances in Carbonate Exploration and Reservoir Analysis The case history approach has an impressive record of success in a variety of disciplines. Collections of case histories, casebooks, are now widely used in all sorts of specialties other than in their familiar application to law and medicine. The case method had its formal beginning at Harvard in 1871 when Christopher Lagdell developed it as a means of teaching. It was so successful in teaching law that it was soon adopted in medical education, and the collection of cases provided the raw material for research on various diseases. Subsequently, the case history approach spread to such varied fields as business, psychology, management, and economics, and there are over 100 books in print that use this approach. The idea for a series of Casebooks in Earth Sciences grew from my experience in organizing and editing a collection of examples of one variety of sedimentary deposits. The project began as an effort to bring some order to a large number of descriptions of these deposits that were so varied in presentation and terminology that even specialists found them difficult to compare and analyze. Thus, from the beginning, it was evident that something more than a simple collection of papers was needed. Accordingly, the nearly fifty contributors worked together with George de Vries Klein and me to establish a standard format for presenting the case histories.

Carbonate Reservoirs The present volume is an intellectual agglomeration covering a variety of topics in diagenesis. It starts with the diagenesis of marine pore waters and soft-sediment deformations, followed by two chapters on sandstones - one on climatic influence in terrestrial sandstone diagenesis and the other on the deep-sea volcaniclastic sandstones. Diagenesis of carbonates is treated next, with one chapter on compactional diagenesis and another devoted to a case study (Aymestry Limestone Beds, UK). There are two chapters on the origin and migration of oil: (a) maturation of organic matter, and (b) relation of diagenesis to mineralization and hydrocarbon reservoir development, followed by a chapter on sedimentary ore genesis - banded iron-formation. In conclusion there are two chapters on paleosols. This book will be of interest to geologists, geochemists and petroleum engineers.

Linking Diagenesis to Sequence Stratigraphy This book provides a comprehensive overview of the parameters and factors that cause heterogeneity in carbonate reservoirs, and examines how they interact with one another. It explores the various scales of heterogeneity, how they are caused, and how they can be minimized, as well as how the scales affect each other, providing practical examples in each chapter. The book concludes by discussing the effect of heterogeneity on petrophysical evaluations. As reducing heterogeneity is the only way to obtain accurate carbonate reservoir characteristics at the regional scale, the book offers an important reference guide for all geologists, engineers, and modelers working with subsurface data.
Diagenesis and Reservoir Quality of the Upper Mississippian Aux Vases Sandstone, Illinois Basin The overarching diagenetic drive during progressive burial of carbonate rocks is toward the loss of porosity through mechanical and chemical compaction (the latter consisting of pressure solution plus related cementation). The passive margin diagenetic regime is marked by relatively rapid burial with steadily rising temperatures and pressures. Once a mechanically stable grain framework is achieved, the effective stress from sediment loading can eventually suffice to cause chemical compaction. Early cementation, the presence of organic frameworks, overpressuring, dolomitization, and especially the filling of reservoir pores with oil all act to retard the onset and efficiency of chemical compaction. Aggressive pore fluids, the presence of metastable mineral phases, and admixtures of siliciclastics or other insolubles tend to accelerate the process. Catagenesis of organic matter in source rocks yields aggressive formation waters capable of calcite dissolution just prior to hydrocarbon maturation. But despite evidence of local late secondary porosity generation, theoretical considerations lead to the conclusion that such evidence represents limited and local porosity rearrangement. Hydrocarbon-filled deep carbonate reservoirs experience progressive loss of porosity with increasing depth, due to precipitation of pyrobitumen as circumgranular linings, and also—during very deep burial—by renewed precipitation of calcite cement (with carbon derived from destruction of methane) and resumption of mechanical and/or chemical compaction. The active margin diagenetic regime is characterized by rapid movement of large volumes of warm-to-hot basinal fluids, mobilized by tectonism, through complex subsurface conduits. Reactions between expelled fluids and conduit carbonates include recrystallization of earlier dolomites and calcites, replacement dolomitization, dissolution of calcite, dolomite and/or evaporites, and sulfide mineralization. Ascending hydrothermal fluids associated with wrench faults and rifting may result in fault-localized leaching of calcite, dolomitization, and dolomite cementation capable of creating or enhancing “hydrothermal dolomite” reservoirs. The most abundant diagenetic product is saddle dolomite. The postorogenic diagenetic regime is characterized by topographically driven meteoric recharge into deeply buried aquifers. There is minimal impact on carbonate porosity unless meteoric waters are dissolving anhydrite/gypsum. Where this occurs, a chemical drive can promote dissolution of dolomite and precipitation of calcite, accompanied by porosity enhancement. In the absence of evaporite dissolution, meteoric waters equilibrate with carbonate aquifers and minimal porosity modification occurs downstream. Crossplots of porosity versus thermal maturity appear to possess porosity predictive capability. Carbonate reservoirs are relatively prone to souring at depth; hydrocarbons in sour reservoirs can be partially or entirely consumed by destructive redox reactions with sulfur in the forms of H2S and S0. The initiation and extent of these reactions depend upon the availability of reactant sulfur (from evaporites and organosulfur compounds) and dissolved iron (derived from Fe-rich siliciclastics, if proximal).

Sandstone Diagenesis Clyde H. Moore

Reservoir Sedimentology Shallow-marine carbonate sequences commonly undergo exposure to meteoric waters. These waters are chemically aggressive toward sedimentary carbonate minerals, capable of rapidly dissolving grains and generating secondary porosity. The carbonate derived from dissolution can precipitate as cement, either nearby or hydrologically downstream, decreasing porosity. Thus the potential for restructuring of original depositional porosity is very high in the meteoric diagenetic environment. Chemical signatures of meteoric pore waters and meteoric carbonate cements are distinct and reflect kinetics of the CaCO3–H2O–CO2 system, climatic effects, and hydrologic setting. The meteoric diagenetic environment is subdivided into vadose and phreatic diagenetic zones. Caliches/calcretes are distinctive diagenetic profiles of uppermost vadose zones in semi-arid climates. Porosity development in vadose diagenetic zones is to a large degree a function of relative sea level, which controls the occurrence of localized floating freshwater lenses (during highstands) versus regional meteoric water systems (during lowstands). Detailed examples presented include Quintana Roo (Mexico) strandplains and Oaks Field (North Louisiana Jurassic), both highstand prograding shoreline systems, and Great Bahama Bank and Barbados (lowstand platform-wide aquifer systems). Geochemical trends in calcite cements and porosity development patterns characteristic of regional meteoric aquifer systems are illustrated from Mississippian Lake Valley Formation grainstones (southwest New Mexico). Karst processes and porosity styles are described in
order that paleokarst features in reservoirs can be recognized and/or predicted. Detailed evaluations of paleokarsted reservoirs include Yates and Ellenburger fields (Permian and Ordovician of West Texas, respectively) and Rospo Mare Field (Cretaceous), Adriatic offshore, Italy. Lastly, the validity and significance of dolomitization associated with meteoric and especially mixed meteoric-marine waters (Dorag model) is evaluated and found to be lacking.

Carbonate Diagenesis Carbonate Reservoirs: Porosity, Evolution and Diagenesis in a Sequence Stratigraphic Framework


An Introduction to Carbonate Sediments and Rocks The petroleum geologist and engineer must have a working knowledge of petrophysics in order to find oil reservoirs, devise the best plan for getting it out of the ground, then start drilling. This book offers the engineer and geologist a manual to accomplish these goals, providing much-needed calculations and formulas on fluid flow, rock properties, and many other topics that are encountered every day. New updated material covers topics that have emerged in the petrochemical industry since 1997. Contains information and calculations that the engineer or geologist must use in daily activities to find oil and devise a plan to get it out of the ground Filled with problems and solutions, perfect for use in undergraduate, graduate, or professional courses Covers real-life problems and cases for the practicing engineer

Carbonate Reservoirs Candidates for this course are recommended to attend the following: - 1- A course for carbonate reservoir characterization due its sever heterogeneity. 2- Surface geological field trips for carbonate exposures. 3- To visit sites of recent carbonate (reefs) preferably by a sub marine glass boat to observe the variation in reef distribution and growth within the same locality.

Carbonate Reservoirs Sequence stratigraphy is a powerful tool for the prediction of depositional porosity and permeability, but does not account for the impact of diagenesis on these reservoir parameters. Therefore, integrating diagenesis and sequence stratigraphy can provide a better way of predicting reservoir quality. This special publication consists of 19 papers (reviews and case studies) exploring different aspects of the integration of diagenesis and sequence stratigraphy in carbonate, siliciclastic, and mixed carbonate-siliciclastic successions from various geological settings. This book will be of interest to sedimentary petrologists aiming to understand the distribution of diagenesis in siliciclastic and carbonate successions, to sequence stratigraphers who can use diagenetic features to recognize and verify interpreted key stratigraphic surfaces, and to petroleum geologists who wish to develop more realistic conceptual models for the spatial and temporal distribution of reservoir quality. This book is part of the set of thematic volumes edited by specialists on subjects of central interest to sedimentologists. Papers are reviewed and printed to the same high standards as those published in the journal. Several of these volumes have become standard works of reference.

Petrophysics One main target in petroleum recovery is the description of the three-dimensional distribution of petrophysical properties on the interwell scale in carbonate reservoirs, in order to improve performance predictions by means of fluid-flow computer simulations. The book focuses on the improvement of geological, petrophysical, and geostatistical methods, describes the basic petrophysical properties, important geology parameters, and rock fabrics from cores, and discusses their spatial distribution. A closing chapter deals with reservoir models as an input into flow
Carbonate Reservoirs: Porosity, Evolution and Diagenesis in a Sequence Stratigraphic Framework
This book is both a review and a look to the future, highlighting challenges for better predicting quantitatively the impact of diagenesis on reservoir rocks. Classical diagenesis studies make use of a wide range of descriptive analytical techniques to explain specific, relatively time-framed fluid-rock interaction processes, and deduce their impacts on reservoir rocks. Future operational workflows will consist of constructing a conceptual diagenesis model, quantifying the related diagenetic phases, and modelling the diagenetic processes. Innovative approaches are emerging for applied quantitative diagenesis, providing numerical data that can be used by reservoir engineers as entry (input) data, and for validating results of numerical simulations. Geometry-based, geostatistical and geochemical modelling do not necessarily mimic natural processes, they rather provide reasonable solutions to specific problems.

Multi-scale Quantitative Diagenesis and Impacts on Heterogeneity of Carbonate Reservoir Rocks An accessible resource, covering the fundamentals of carbonatereservoir engineering Includes discussions on how, where and why carbonate are formed, plus reviews of basic sedimentological and stratigraphic principles to explain carbonate platform characteristics and stratigraphic relationships Offers a new, genetic classification of carbonate porosity that is especially useful in predicting spatial distribution of pore networks. Includes a solution manual

Carbonate Petroleum Reservoirs This volume highlights key challenges for fluid-flow prediction in carbonate reservoirs, the approaches currently employed to address these challenges and developments in fundamental science and technology. The papers span methods and case studies that highlight workflows and emerging technologies in the fields of geology, geophysics, petrophysics, reservoir modelling and computer science. Topics include: detailed pore-scale studies that explore fundamental processes and applications of imaging and flow modelling at the pore scale; case studies of diagenetic processes with complementary perspectives from reactive transport modelling; novel methods for rock typing; petrophysical studies that investigate the impact of diagenesis and fault-rock properties on acoustic signatures; mechanical modelling and seismic imaging of faults in carbonate rocks; modelling geological influences on seismic anisotropy; novel approaches to geological modelling; methods to represent key geological details in reservoir simulations and advances in computer visualization, analytics and interactions for geoscience and engineering.

Carbonate Reservoirs

ICIPEG 2016 This book presents selected articles from the workshop on "Challenges in Petrophysical Evaluation and Rock Physics Modeling of Carbonate Reservoirs" held at IIT Bombay in November 2017. The articles included explore the challenges associated with using well-log data, core data analysis, and their integration in the qualitative and quantitative assessment of petrophysical and elastic properties in carbonate reservoirs. The book also discusses the recent trends and advances in the area of research and development of carbonate reservoir characterization, both in industry and academia. Further, it addresses the challenging concept of porosity portioning, which has huge implications for exploration and development success in these complex reservoirs, enabling readers to understand the varying orders of deposition and diagenesis and also to model the flow and elastic properties.

Carbonate Sedimentology

Carbonate Reservoirs The 2nd Edition of Carbonate Reservoirs aims to educate graduate students and industry professionals on the complexities of porosity evolution in carbonate reservoirs. In the intervening 12 years since the first edition, there have been numerous studies of value published that need to be recognized and incorporated in the topics discussed. A chapter on the impact of global tectonics and biological evolution on the carbonate system has been added to emphasize the
effects of global earth processes and the changing nature of life on earth through Phanerozoic time on all aspects of the carbonate system. The centerpiece of this chapter—and easily the most important synthesis of carbonate concepts developed since the 2001 edition—is the discussion of the CATT hypothesis, an integrated global database bringing together stratigraphy, tectonics, global climate, oceanic geochemistry, carbonate platform characteristics, and biologic evolution in a common time framework. Another new chapter concerns naturally fractured carbonates, a subject of increasing importance, given recent technological developments in 3D seismic, reservoir modeling, and reservoir production techniques. Detailed porosity classifications schemes for easy comparison
Overview of the carbonate sedimentologic system Case studies to blend theory and practice

Diagenesis, III

Petro-physics and Rock Physics of Carbonate Reservoirs

Fundamental Controls on Fluid Flow in Carbonates A comprehensive series of carbonate diagenesis/porosity models summarize the concepts developed in previous chapters, emphasizing the predictable loci of major porosity modification and enhancement. Each model refers to a specific combination of (1) setting (carbonate ramp, land-tied shelf, or isolated platform), (2) climate regime (humid or arid), and (3) sea-level cycle phase (TST, HST, or LST). Diagenetic processes at the parasequence scale reflect third-order sea-level cycles. During the TST and early HST, parasequences trend to be thick, with marine diagenesis dominating. Parasequences progressively thin during the HST, with exposure at cycle tops and meteoric influence becoming more important. During the late HST and the LST, subaerial diagenesis dominates. Third-order sedimentary sequences exhibit stacking geometries that reflect background second-order sea-level trends. Retrogradational sequence sets develop during second-order sea-level rise (e.g., in rift or foreland basins). Such sequence sets show relative domination by marine diagenesis. Aggradational sequence sets develop during second-order sea-level stillstand to moderate rise (e.g., early post-rift phase in extensional basins). Moderate meteoric water diagenesis and porosity modification occur at sequence boundaries, followed by burial diagenesis. Progradational sequence sets develop on passive margins during second-order sea-level stillstand to fall. This setting supports deep, amalgamated karstification, extensive phreatic meteoric diagenesis, and—under arid conditions—reflux dolomitization. First-order Icehouse conditions are characterized by high-frequency, high-amplitude sea-level cycles that favor development of rimmed carbonate shelves. The mainly aragonitic sediments deposited on these aggraded shelves experience high degrees of meteoric diagenesis and porosity modification. Greenhouse conditions are characterized by lower-frequency, low-amplitude sea-level cycles that favor development of carbonate ramps. The calcite sediments deposited here result in relatively muted meteoric diagenesis and porosity modifications. Two case histories illustrate the basic concepts of early diagenetic porosity evolution: (1) the Southwest Andrews Area, an Icehouse Permian–Pennsylvanian rimmed shelf margin reservoir (Permian, West Texas), and (2) ramp sequences of the Kwanza and Lower Congo basins, Greenhouse Albian Pinda Group (Cretaceous, offshore Angola).

Reservoir Quality of Clastic and Carbonate Rocks Diagenesis affects all sediments after their deposition and includes a fundamental suite of physical, chemical and biological processes that control the texture, mineralogy and fluid-flow properties of sedimentary rocks. Understanding the processes and products of diagenesis is thus a critical component in the analysis of the evolution of sedimentary basins, and has practical implications for subsurface porosity destruction, preservation and generation. This in turn is of great relevance to the petroleum and water industries, as well as to the location and nature of some economic mineral deposits. Combines key papers in sandstone diagenesis published in Sedimentology over the last 30 years. Records the development of diagenesis from the description of grain shapes through provenance, petrography and analytical geochemistry to predictive models of diagenetic process. Provides definitions and explanations of the terms and concepts used in diagenesis. If you are a member of the International Association of Sedimentologists, for purchasing details, please see: http://www.iasnet.org/publications/details.asp?code=RP4
Carbonate Reservoirs Carbonate rocks (limestones and dolomites) constitute a major part of the geological column and contain not only 60% of the world's known hydrocarbons but also host extensive mineral deposits. This book represents the first major review of carbonate sedimentology since the mid 1970's. It is aimed at the advanced undergraduate–postgraduate level and will also be of major interest to geologists working in the oil industry. Carbonate Sedimentology is designed to take the reader from the basic aspects of limestone recognition and classification through to an appreciation of the most recent developments such as large scale facies modelling and isotope geochemistry. Novel aspects of the book include a detailed review of carbonatemineralogy, non-marine carbonate depositional environments and an in-depth look at carbonate deposition and diagenesis through geologic time. In addition, the reviews of individual depositional systems stress a process-based approach rather than one centered on simple comparative sedimentology. The unique quality of this book is that it contains integrated reviews of carbonate sedimentology and diagenesis, within one volume.

Carbonate Reservoirs

Carbonate Reservoir Characterization Carbonate reservoirs contain an increasingly important percentage of the world's hydrocarbon reserves. This volume presents key recent advances in carbonate exploration and reservoir analysis.

Carbonate Reservoirs

Carbonate Rock Depositional Models

Carbonate Reservoirs The 2nd Edition of Carbonate Reservoirs aims to educate graduate students and industry professionals on the complexities of porosity evolution in carbonate reservoirs. In the intervening 12 years since the first edition, there have been numerous studies of value published that need to be recognized and incorporated in the topics discussed. A chapter on the impact of global tectonics and biological evolution on the carbonate system has been added to emphasize the effects of global earth processes and the changing nature of life on earth through Phanerozoic time on all aspects of the carbonate system. The centerpiece of this chapter—and easily the most important synthesis of carbonate concepts developed since the 2001 edition—is the discussion of the CATT hypothesis, an integrated global database bringing together stratigraphy, tectonics, global climate, oceanic geochemistry, carbonate platform characteristics, and biologic evolution in a common time framework. Another new chapter concerns naturally fractured carbonates, a subject of increasing importance, given recent technological developments in 3D seismic, reservoir modeling, and reservoir production techniques. Detailed porosity classifications schemes for easy comparison Overview of the carbonate sedimentologic system Case studies to blend theory and practice

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