



# REVIEWS IN ECONOMIC GEOLOGY

(ISSN 0741-0123)

Volume 5

## SEDIMENTARY AND DIAGENETIC MINERAL DEPOSITS: A BASIN ANALYSIS APPROACH TO EXPLORATION

ISBN 0-9613074-4-7

### Volume Editors

**E. R. FORCE**  
U.S. Geological Survey  
Gould-Simpson Bldg.  
University of Arizona  
Tucson, AZ 85721

**J. J. EIDEL**  
Illinois State Geological Survey  
615 E. Peabody Drive  
Champaign, IL 61820  
**Short Course Convener**

**J. B. MAYNARD**  
Department of Geology  
University of Cincinnati  
Cincinnati, OH 45221-0013

**Series Editor:** JAMES M. ROBERTSON  
New Mexico Bureau of Mines & Mineral Resources  
Campus Station  
Socorro, NM 87801

SOCIETY OF ECONOMIC GEOLOGISTS



# CONTENTS

## Part I: Introduction

<b>Chapter 1—BASIN ANALYSIS FOR THE MINERAL INDUSTRY</b> .....	1
THE ROLE OF BASIN ANALYSIS IN EXPLORATION FOR SEDIMENT-HOSTED ORE DEPOSITS .....	1
WORLD-CLASS ORE DEPOSITS, BASIN TYPE AND HISTORY .....	5
VARIATION IN ORE DEPOSITS AND BASINS THROUGH GEOLOGIC TIME .....	8
ORE MINERAL OCCURRENCES AND DEPTH OF MINERALIZATION .....	8
DATA SOURCES FOR BASIN ANALYSIS .....	8
ADVANCES IN GEOLOGY, GEOCHEMISTRY, AND GEOPHYSICS THAT APPLY TO EXPLORATION FOR SEDIMENT-HOSTED ORE DEPOSITS .....	10
CRUSTAL PROCESSES .....	10
LABORATORY TECHNIQUES .....	11
COMPUTER TECHNIQUES .....	11
REFERENCES .....	11
APPENDIX .....	13

<b>Chapter 2—SEDIMENTARY PROCESSES AS ORE-FORMING PROCESSES</b> .....	17
SEQUENTIAL EVOLUTION OF SYNSEDIMENTARY AND DIAGENETIC ORE DEPOSITS .....	17
SOLUTION INTERFACES AS LOCI OF MASSIVE PRECIPITATION .....	17
THE STRATIGRAPHIC COLUMN AS SUCCESSIVE EQUILIBRIA .....	18
SYNSEDIMENTARY DEPOSITS AND BASIN ANALYSIS .....	19
PALEOCLIMATE .....	20
REFERENCES .....	20

## Part II: Basin Analysis and Sedimentary Processes

<b>Chapter 3—RATIONALE FOR MODERN BASIN ANALYSIS APPLIED TO ORE DEPOSITS</b> .....	21
BRIEF HISTORY OF BASIN ANALYSIS .....	21
HEAT FLUX AND FLUID FLOW .....	22
A NEW VIEW OF THE STRATIGRAPHIC RECORD .....	22
THE FUTURE OF SEDIMENTARY GEOLOGY .....	23

<b>Chapter 4—BASIN-FORMING PROCESSES</b> .....	25
ISOSTASY .....	25
THERMAL SUBSIDENCE .....	27
FLEXURAL SUBSIDENCE .....	31
INTRAPLATE STRESS .....	34
TECTONIC SUBSIDENCE AND GEOHISTORY ANALYSIS .....	36

<b>Chapter 5—SEDIMENTARY BASIN CLASSIFICATION</b> .....	43
INTRODUCTION .....	43
PLATE TECTONIC BASIN CLASSIFICATIONS .....	43

<b>CLASSIFICATION USED IN THIS CHAPTER</b> .....	45
CRITERIA .....	45
BASIN TYPES .....	46
<b>TECTONIC VERSUS GEOCHEMICAL BASIN CLASSIFICATION</b> .....	47

<b>Chapter 6—BASIN SEDIMENTOLOGY AND STRATIGRAPHY—THE BASIN FILL</b> .....	51
PALEOGEOGRAPHY .....	51
MODERN PALEOGEOGRAPHIC PRINCIPLES .....	51
PALEO-UPWELLING .....	52
PALEO-DISTRIBUTION OF CARBONATE ROCKS .....	52
<b>BASIN CLASTIC SEDIMENTOLOGY AND FACIES</b> .....	54
INTRODUCTION .....	54
ALLUVIAL FANS .....	56
BRAIDED STREAMS .....	57
ANASTOMOSING STREAMS .....	58
MEANDERING STREAMS .....	58
EOLIAN SAND BODIES .....	58
COASTAL BARRIER ISLAND SYSTEMS .....	58
INTERTIDAL FLATS .....	58
DELTA .....	59
CONTINENTAL SHELVES .....	59
SUBMARINE FANS .....	59
SUMMARY OF SANDSTONE VERTICAL SEQUENCES .....	61
BLACK SHALES .....	62
<b>BASIN STRATIGRAPHY</b> .....	64
INTRODUCTION .....	64
CRATONIC SEQUENCES .....	64
SEA LEVEL, SEQUENCE AND SEISMIC STRATIGRAPHY .....	66
SEA-LEVEL EVOLUTION .....	68
CRITIQUE OF SEA-LEVEL CURVES BY VAIL ET AL. (1977A) AND HAQ ET AL. (1987, 1988) .....	73
IMPACT OF SEA-LEVEL ANALYSIS ON STRATIGRAPHIC CONCEPTS .....	78
TRANSGRESSIVE-REGRESSIVE SEQUENCES .....	79
<b>GLOBAL SEDIMENTARY CYCLES</b> .....	80
TWO PHANEROZOIC SUPERCYCLES .....	83
MILANKOVITCH CYCLES .....	87

<b>Chapter 7—DIAGENESIS AND FLUID MOVEMENT—BASIN MATURATION</b> .....	91
INTRODUCTION .....	91
SANDSTONE DIAGENESIS .....	91
SIMPLIFIED OVERVIEW OF ORGANIC CHEMISTRY .....	95
BASIN HYDROGEOLOGY .....	97

<b>Chapter 8—SYNTHESIS: BRIEF EXAMPLES OF BASIN ANALYSIS</b> .....	103
INTRODUCTION .....	103
BASIN ANALYSIS OF THE NORTH SEA .....	103
ARKOMA BASIN .....	110
PACIFIC OCEAN BACKARC BASINS .....	113
ILLINOIS BASIN .....	115
ORIGIN OF CRATONIC BASINS .....	118

<b>Part II: References</b> .....	121
----------------------------------	-----

