

INFORMATION SYNTHESIS
FOR MINERAL EXPLORATION

Guocheng Pan

DeVerle P. Harris

OXFORD
UNIVERSITY PRESS

2000

Contents

1. INTRODUCTION 3
 - 1.1 What this Book Is About 3
 - 1.2 Content and Organization of this Book 5
 - 1.3 Selective Comments about Book Content 7

2. MINERAL RESOURCES INFORMATION SYSTEM 13
 - 2.1 Perspective 13
 - 2.2 Earth Processes and Geological Objects 14
 - 2.3 Deposits as Geological Objects 15
 - 2.4 Concepts of Mineral Resources and Reserves 21
 - 2.5 Geodata as Quantified Resource Information 29
 - 2.6 Information on the Third Dimension 41

3. THE INVERSE PROBLEM: FROM GEODATA TO RESOURCE OBJECTS 44
 - 3.1 Roles of Genetic Models 44
 - 3.2 Intrinsic Geological Units 46
 - 3.3 A Conceptual Model of Targets 56
 - 3.4 Overview of Information Synthesis 61
 - 3.5 Mineral Potential Measures 74

4. THE FUNDAMENTALS OF GEOGRAPHIC INFORMATION SYSTEMS 85
 - 4.1 Basic GIS Functions 85
 - 4.2 Spatial Data Models 91
 - 4.3 Map Representation 97
 - 4.4 Spatial Data Operations 108
 - 4.5 GIS Implementation Procedure 121

5. STATISTICAL MEASURES OF ASSOCIATION 127
 - 5.1 Variable Types 127
 - 5.2 Association Measures for Quantitative Variables 129
 - 5.3 Association Measures of Qualitative Variables 137
 - 5.4 Association Measures of Mixed Variables 150

6. MAP ATTRIBUTE MODELING 154
 - 6.1 Map Attribute Quantification 154
 - 6.2 Point Pattern Modeling 160
 - 6.3 Mapping Geological Attributes 170
 - 6.4 Selecting Attributes 180

7. ENHANCING SPATIAL INFORMATION 194

- 7.1 Zonation Analysis 195
- 7.2 Trend Surface Analysis 215
- 7.3 Basic Digital Image Processing 222
- 7.4 Signal Processing 242

8. GEOSTATISTICAL MODELING 268

- 8.1 Brief Review 268
- 8.2 The Fundamentals of Regionalization 269
- 8.3 Variogram Modeling 275
- 8.4 Linear Interpolation 299
- 8.5 Conditional Simulation 317

**9. FAVORABILITY ANALYSIS FOR MINERAL
POTENTIAL MAPPING 336**

- 9.1 Concepts and Illustrations 336
- 9.2 Characteristic Analysis 345
- 9.3 Canonical Favorability Analysis 350
- 9.4 Weights of Evidence Modeling 374

10. ARTIFICIAL INTELLIGENCE METHODS 391

- 10.1 Overview 391
- 10.2 Neural Networks 392
- 10.3 Intelligent Systems 422

References 439

Index 457